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APPENDIX L.

REPORT OF LIEUT. COL. CHAS. J. ALLEN, CORPS OF ENGINEERS.

Improvements.—Potomac River at Washington, D. C., 1702; Potomac River below Washington, D. C., 1706; Occoquan Creek, Va., 1709; Nomini Creek, Va., 1711; Lower Machodoc Creek, Va., 1714; Rappahannock River, Va., 1715; Urbana Creek, Va., 1717; harbor at Milford Haven, Va., 1719; York River, Va., 1721; Mattaponi River, Va., 1722; Pamunkey River, Va., 1724; James River, Va., 1725; Jamestown Island, Va., 1736; removing sunken vessels or craft obstructing or endangering navigation, 1738.

Examinations and Surveys.—Patuxent River, Md., 1739; Breton Bay, Md, 1743; Carters Creek, Va., 1747; Jacksons Creek, Middlesex County, Va., 1753; James River at Richmond, Va., 1754.

Harbor Lines.—James River at Richmond, Va., 1761.

APPENDIX M.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

Improvements.—Harbor at Norfolk and its approaches, Va., 1763; Western Branch of Elizabeth River, Va., Nansemond River, Va., 1765; Appomattox River, Va., 1766; harbor at Cape Charles City, Va., 1768; Nandua Creek, Va., 1771; waterway from Norfolk, Va., to the sounds of North Carolina, 1773; inland water route from Norfolk, Va., to Albemarle Sound, N. C., through Currituck Sound, 1778; Edenton Bay, N. C., 1780; Roanoke River, N. C., 1782; removing sunken vessels or craft obstructing or endangering navigation, 1783.

Examination and Survey.—Middle Ground Bar, Hampton Roads, Va., 1785.

Harbor Lines.—Elizabeth River, at Norfolk, Va., 1791.

PART III.

APPENDIX N.

REPORT OF CAPT. E. W. VAN C. LUCAS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ocracoke Inlet, N. C., 1793; Fishing Creek, N. C., 1796; Pamlico and Tar rivers, N. C., 1798; Contentnia Creek, N. C., 1801; Trent River, N. C., 1802; Neuse River, N. C., 1804; inland waterway between Newbern and Beaufort, N. C., 1806; harbor at Beaufort, N. C., 1808; inland waterway between Beaufort Harbor and New River, N. C., 1810; New River, N. C., 1812; Black River, N. C., 1813; Northeast (Cape Fear) River, N. C., 1815; Cape Fear River, N. C., above Wilmington, 1816; Cape Fear River, N. C., at and below Wilmington, 1818; Town Creek, Brunswick County, N. C., 1827.

EXAMINATIONS AND SURVEY.—Harbor of refuge, Cape Lookout, N. C., 1829.

HARBOR LINES.—Trent and Neuse rivers at Newbern, N. C., 1837.

APPENDIX O.

REPORT OF CAPT. J. C. SANDFORD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Waccamaw River, N. C. and S. C., 1841; Little Pedee River, S. C., 1845; Great Pedee River, S. C., 1847; Georgetown Harbor, S. C., 1850; Winyah Bay, S. C., 1851; Santee River, S. C., 1856; Wateree River, S. C., 1860; Congaree River, S. C., 1863; Congaree River, S. C., from Gervais Street Bridge, Columbia, to Granby, 1864; harbor at Charleston, including Sullivans Island and Mount Pleasant Shore, S. C., 1867; Wappoo Cut, S. C., 1872; Beaufort River, S. C., 1873; removing sunken vessels or craft obstructing or endangering navigation, 1875.

EXAMINATIONS AND SURVEYS.—Lynchs River, S. C., 1876; Sampit River, S. C., 1883; Estherville-Minim Creek Canal to Alligator River, S. C., 1894; Wee Tee Lake, Williamsburg County, S. C., 1903; waterways between Charleston Harbor and Alligator Creek, S. C., 1908.

APPENDIX P.

REPORT OF CAPT. CASSIUS E. GILLETTE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Savannah Harbor, Ga., 1913; Savannah River, Ga., 1928; Savannah River above Augusta, Ga., 1930; Doboy Bar, Ga., 1933; Darien Harbor, Ga., 1935; Altamaha River, Ga., 1939; Oconee River, Ga., 1942; Ocmulgee River, Ga., 1944; Brunswick Harbor, Ga., 1948; inside water route between Savannah, Ga., and Fernandina, Fla., 1953; Cumberland Sound, Ga. and Fla., 1956; removing sunken vessels or craft obstructing or endangering navigation, 1961.

EXAMINATION AND SURVEY.—Brunswick, Ga., inner harbor, 1962.

APPENDIX Q.

REPORT OF CAPT. C. H. McKINSTRY, CORPS OF ENGINEERS.

IMPROVEMENTS.—St. Johns River, Fla., 1967; St. Johns River at Orange Mills Flats, Fla., 1972; Volusia Bar, Fla., 1978; Ocklawaha River, Fla., 1980; St. Augustine Harbor, Fla., 1981; Indian River, Fla., 1982; harbor at Key West, Fla., and entrance thereto, 1983; removing the water hyacinth from Florida waters, dredge for river and harbor improvements, Fla., 1985.

EXAMINATION.—Biscayne Bay, Fla., from Miami to the sea, via Norris Cut, Bears Cut, and Cape Florida Entrance, respectively, 1986.

APPENDIX R.

REPORT OF CAPT. THOS. H. REES, CORPS OF ENGINEERS.

IMPROVEMENTS.—Caloosahatchee River, Fla., 2015; Charlotte Harbor and Peace Creek, Fla., 2017; Sarasota Bay, Fla., 2018; Manatee River, Fla., 2020; Tampa Bay, Fla., 2022; Hillsboro Bay, Fla., 2025; Anclote River, Fla., 2028; Withlacoochee River, Fla., 2029; Suwanee River, Fla., 2030; removing sunken vessels or craft obstructing or endangering navigation, 2032.

EXAMINATIONS AND SURVEYS.—Orange River, Fla., to the Caloosahatchee, thence to the Gulf, 2032; inside passage from Punta Rasa to Charlotte Harbor, Fla., 2041; Boca Grande and Charlotte Harbor, Fla., 2048; inside passage through Sarasota Bay to Lemon Bay, Fla., 2054; Bay at Hudson, Pasco County, Fla, 2166; Crystal River, Fla., 2074.

HARBOR LINES.—Hillsboro River at Tampa, Fla., 2084.

APPENDIX S.

REPORT OF CAPT. C. A. F. FLAGLER, CORPS OF ENGINEERS.

Improvements.—Carrabelle Bar and Harbor, Fla., 2088; Apalachicola Bay, Fla., 2091; Apalachicola River, the Cut-off, and lower Chipola River, Fla., 2095; upper Chipola River, Fla., from Marianna to its mouth, 2099; Flint River, Ga., 2101; Chattahoochee River, Ga. and Ala., 2106; Choctawhatchee River, Fla. and Ala., 2112; Lagrange Bayou, Fla., including Holmes River from Vernon to its mouth, 2116; Pensacola Harbor, Fla., 2118; Blackwater River, Fla., 2126; Escambia and Conecuh rivers, Fla. and Ala., 2129; Alabama River, Ala., 2132; Coosa River, Ga. and Ala., 2137; operating and care of canals and other works of navigation on Coosa River, Ga. and Ala., 2145.

Examinations and Surveys.—Ocklockonnee River, Fla., 2146; East Pass at entrance to Carrabelle Harbor, Fla., 2152.

Harbor Lines.—St. Georges Sound at Dog Island, Fla., 2158.

APPENDIX T.

REPORT OF MAJ. WM. T. ROSSELL, CORPS OF ENGINEERS.

Improvements.—Harbor at Mobile, Ala., 2161; Black Warrior River, Ala., from Tuscaloosa to Daniels Creek, 2167; operating and care of locks and dams on Black Warrior River, Ala., 2171; Warrior and Tombigbee rivers, Ala. and Miss., 2177; Noxubee River, Miss, 2208; Pascagoula River Miss., 2209; Pascagoula River and Horn Island Harbor, Miss., 2211; Chickasahay River, Miss., 2213; Leaf River, Miss., 2215; channel from Gulfport to Ship Island Harbor, Miss., Ship Island Pass, Miss., 2216; Pearl River at mouth, Miss., 2217; Pearl River below Jackson, Miss., 2218; Pearl River between Carthage and Jackson, Miss., 2220; Pearl River between Edinburg and Carthage, Miss., 2221; Bogue Chitto, La., 2222; removing sunken vessels or craft obstructing or endangering navigation, 2223.

APPENDIX U.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

Inspection of the improvement of the South Pass of the Mississippi River, 2225.

APPENDIX V.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

Improvements.—Chefunte River and Bogue Falia, La., 2240; Tickfaw River and its tributaries, La., 2241; Amite River and Bayou Manchac, La., 2243; closing crevasse in Pass a Loutre, Mississippi River, 2245; outlet of the Mississippi River, 2246; bayou Lafourche, La., 2249; Bayou Plaquemine, Grand River, and Pigeon bayous, La., 2251; Bayou Courtableau, La., 2259; Bayou Teche, La., 2260; channel, bay, and passes of Bayou Vermilion, La., 2262; Mermentau River and tributaries, La., 2264; mouth and passes of Calcasieu River, La., 2266; Johnsons Bayou, La., 2268; removing water hyacinths from Louisiana waters, 2270; mouths of Sabine and Neches rivers, Tex., 2272; Sabine River, Tex., 2274; harbor at Sabine Pass, Tex., 2276; Homochitto River, Miss., 2280; removing sunken vessels or craft obstructing or endangering navigation, 2282.

Examinations and Surveys.—Atchafalaya Bay, La., 2282; Southwest Pass, Mississippi River, 2287; channel through Sabine Lake, Tex. and La., 2302.

PART IV.

APPENDIX W.

REPORT OF CAPT. C. S. RICHÉ, CORPS OF ENGINEERS.

Improvements.—Galveston Harbor, Tex., 2308; ship channel in Galveston Bay, Tex., 2325; channel from Galveston Harbor to Texas City, Tex., 2326; Galveston Ship Channel and Buffalo Bayou, Tex., 2327; operating and care of Morgans Canal, Tex., 2328; Trinity River, Tex., 2329; Buffalo Bayou, Tex., 2330; channel in West Galveston Bay, Tex., 2331; mouth of Brazos River, Tex., 2332; Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of the adjacent streams, Tex., 2334; Brazos River, Tex., 2335; Aransas

Pass, Tex., 2336; harbor at Brazos Santiago, Tex., 2340; removing sunken vessels or craft obstructing or endangering navigation, 2341.

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Harbor Lines.—Galveston Harbor, Tex., at Fort San Jacinto, 2475; San Jacinto Bay at Laporte, Tex., 2476.

APPENDIX X.

REPORT OF MAJ. THOS. L. CASEY, CORPS OF ENGINEERS.

Improvements.—Red River, La., Ark., and Ind. Ter., 2480; Cypress Bayou, Tex. and La., 2502; Ouachita and Black rivers, Ark and La., 2503; Bayou Bartholomew, La. and Ark., 2513; Bœuf River, La., 2515; Tensas River and Bayou Maçon, La., 2517; Yazoo River, Miss., 2519; mouth of Yazoo River and harbor at Vicksburg, Miss., 2524; Tallahatchie River, Miss., 2534; Big Sunflower River, Miss., 2537; water gauges on Mississippi River and its principal tributaries, 2540.

Examinations and Surveys.—Ouachita and Black rivers, Ark. and La., 2544; Red River, Tex., 2565; Alexandria Harbor, La., 2569.

APPENDIX Y.

REPORT OF CAPT. ROBERT McGREGOR, CORPS OF ENGINEERS.

Improvements.—Removing obstructions in Arkansas River, Ark. and Kans., 2577; Arkansas River, Ark., 2581; White River, Ark., 2592; Upper White River, Ark., 2596; Buffalo Fork of White River, Ark., 2601; Cache River, Ark., 2602; Black River, Ark. and Mo., 2604; Current River, Ark. and Mo., 2608; St. Francis River, Ark., 2610; removing sunken vessels or craft obstructing or endangering navigation, 2613.

Examinations.—Current River, Mo., 2614; St. Francis River, Mo., 2618.

APPENDIX Z.

REPORT OF CAPT. EDW. BURR, CORPS OF ENGINEERS.

Improvements.—Removing snags and wrecks from Mississippi River below Missouri River, 2621; Mississippi River between Ohio and Missouri rivers, 2631; harbor at St. Louis, Mo., 2664; to prevent the Mississippi River from breaking through into the Cache River at Beechridge, above Cairo, Ill., 2666.

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APPENDIX A A.

REPORT OF MAJ. C. McD. TOWNSEND, CORPS OF ENGINEERS.

Improvements.—Operating snag boats and dredge boats on Upper Mississippi River, 2679; Mississippi River between mouth of Missouri River and St. Paul, 2692; operating and care of Des Moines Rapids Canal and Dry Dock, 2744; operating and care of Galena River improvement, Ill., 2752; harbor at La Crosse, Wis., 2755.

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APPENDIX B B.

REPORT OF MAJ. F. V. ABBOT, CORPS OF ENGINEERS.

Improvements.—Mississippi River, between St. Paul and Minneapolis, Minn., 2768; construction of reservoirs at headwaters of Mississippi River, 2786; operating and care of reservoirs at headwaters of Mississippi River, 2800; Chippewa River, including yellow banks, Wis., 2806; St. Croix River, Wis. and Minn., 2809; Minnesota River, Minn., 2812; Red River of the North, Minn. and N. Dak., 2814; bar at mouth of Warroad River, Minn., 2820; gauging Mississippi River at or near St. Paul, Minn., 2821.

EXAMINATIONS AND SURVEYS.—Red Lake and Red Lake River, Minn., 2828; Otter Tail Lake and Otter Tail River, Minn., 2830; Big Stone Lake and Lake Traverse, Minn. and S. Dak., 2833; St. Croix River, Minn., 2836; Minnesota River, Minn., 2840; Red River of the North, Minn. and N. Dak., 2841.

APPENDIX C C.

REPORTS OF LIEUT. COL. AMOS STICKNEY, CORPS OF ENGINEERS, PRESIDENT MISSOURI RIVER COMMISSION.

PRELIMINARY examinations and surveys of Missouri River at Huntsdale and Napoleon, Mo., 2847, 2852.

APPENDIX D D.

REPORT OF CAPT. H. M. CHITTENDEN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Missouri River between Stubbs Ferry, Mont., and lower limits of Sioux City, Iowa, 2859; snagging Upper Missouri River, 2882.

APPENDIX E E.

REPORT OF LIEUT. COL. M. B. ADAMS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Obion River, Tenn., 2887; Forked Deer River, Tenn., 2889; Cumberland River, Tenn. and Ky., 2891.

PART V.

APPENDIX F F.

REPORT OF MAJ. DAN C. KINGMAN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tennessee River, 2907; operating and care of Muscle Shoals Canal, Tennessee River, 2934; French Broad River and Little Pigeon River, Tenn., 2944; Clinch River, Tenn. and Va., 2948; Elk River, Tenn. and Ala., 2952.

EXAMINATIONS AND SURVEYS.—Tennessee River at the "Suck," or mountain section, below Chattanooga, Tenn., 2956; Tennessee River at Moccasin Bend, below Chattanooga, Tenn., 3005; Tennessee River between Bridgeport and Decatur, Ala., 3008; Hiwassee River, Tenn., 3010; French Broad River, Tenn., 3018; Holston River, Tenn., 3058; Clinch River, Tenn., 3065; Powells River, Va. and Tenn., 3067; Richland River, Tenn., 3074; Elk River, Tenn. and Ala., 3077.

APPENDIX G G.

REPORT OF MAJ. W. H. BIXBY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ohio River, 3085; operating snag boat on the Ohio River, 3129; operating and care of Davis Island Dam, Ohio River, 3140; movable dams in Ohio River, 3146.

EXAMINATIONS AND SURVEYS.—Licking River, Ky., 3155; Ohio River from Mound City to Cairo, Ill., 3185; Ohio River at or near New Liberty, Ill., 3191; Ohio River from Marietta, Ohio, to mouth of Big Miami River, 3201; Ohio River at Madison, Ind., 3215; river bank at Paducah, Ky. (Tennessee River), 3219.

APPENDIX H H.

REPORT OF MAJ. CHAS. F. POWELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Monongahela River, W. Va., 3225; Monongahela River, Pa., 3228; operating and care of locks and dams, Monongahela River, W. Va. and Pa., 3233; harbor of Pittsburg, Pa., 3254; construction of locks and dams at Herr Island, above head of Six-mile Island, and at Springdale, Allegheny River, 3257; Allegheny River, Pa., 3263.

EXAMINATIONS AND SURVEY.—West Fork River, W. Va., 3267; Youghiogheny River, Pa., from West Newton to its mouth, 3283.

APPENDIX I I.

REPORT OF CAPT. H. F. HODGES, CORPS OF ENGINEERS.

IMPROVEMENTS.—Muskingum River, Ohio, 3297; operating and care of locks and dams on Muskingum River, Ohio, 3300; Little Kanawha River, W. Va., 3317; operating and care of lock and dam on Little Kanawha River, W. Va., 3319; Kanawha River, W. Va., 3322; operating and care of locks and dams on Kanawha River, W. Va., 3325; Elk River, W. Va., 3337; Gauley River, W. Va., 3340; Guyandot River, W. Va., 3343; Big Sandy River, W. Va. and Ky., 3347; operating and care of lock and dam in Big Sandy River, W. Va. and Ky., 3353; Tug Fork of Big Sandy River, W. Va. and Ky., 3357; Levisa Fork of Big Sandy River, Ky., 3360; Kentucky River, Ky., 3363; operating and care of locks and dams in Kentucky River, Ky., 3369.

EXAMINATIONS AND SURVEY.—Elk River, W. Va., 3392; Guyandot River, W. Va., 3396; Big Sandy River, W. Va. and Ky., including Levisa and Tug forks, 3400.

APPENDIX J J.

REPORT OF CAPT. GEO. A. ZINN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Falls of the Ohio River at Louisville, Ky., 3463; operating and care of Louisville and Portland Canal, Ky., 3482; Wabash River, Ind. and Ill., 3497; operating and care of lock and dam at Grand Rapids, Wabash River, 3498; White River, Ind., 3500; Green river, Ky., 3501; operating and care of locks and dams on Green and Barren rivers, Ky., 3516; Rough River, Ky., 3539; operating and care of lock and dam in Rough River, Ky., 3541.

EXAMINATION.—Green River, Ky., 3542.

APPENDIX K K.

REPORT OF MAJ. CLINTON B. SEARS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor at Grand Marais, Minn., 3547; harbor at Agate Bay, Minn., 3551; harbor at Duluth, Minn., and Superior, Wis., 3554; harbor at Ashland, Wis., 3592; harbor at Ontonagon, Mich., 3595; waterway from Keweenaw Bay to Lake Superior, Mich., 3598; harbor at Marquette, Mich., 3606; harbor of refuge, Marquette Bay, Mich., 3608; harbor of refuge at Grand Marais, Mich., 3610.

EXAMINATIONS AND SURVEYS.—Canal between Lake Superior and Mississippi River, 3613; harbor of refuge at Two Islands, or Saxton, Minn., 3629; harbor at Portwing, Wis., 3630; Copper Harbor, Mich., 3636.

HARBOR LINES.—Duluth and Superior Harbor, Minn. and Wis., 3642.

APPENDIX L L.

REPORT OF CAPT. J. G. WARREN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Menominee Harbor, Mich. and Wis., 3650; Menominee River, Mich. and Wis., 3653; Oconto Harbor, Wis., 3654; Green Bay Harbor, Wis., 3657; Sturgeon Bay and Lake Michigan Ship Canal, Wis., 3659; operating and care of Sturgeon Bay and Lake Michigan Ship Canal, Wis., 3666; harbor of refuge at entrance of Sturgeon Bay and Lake Michigan Ship Canal, Wis., 3672; Ahnapee Harbor, Wis., 3674; Kewaunee Harbor, Wis., 3679; Two Rivers Harbor, Wis., 3681; Manitowoc Harbor, Wis., 3683; Sheboygan Harbor, Wis., 3687; Port Washington Harbor, Wis., 3692; harbor of refuge at Milwaukee, Wis., 3695; Milwaukee Harbor, Wis., 3697; South Milwaukee Harbor, Wis., 3701; Racine Harbor, Wis., 3702; Kenosha Harbor, Wis., 3706; Waukegan Harbor, Ill., 3709; Fox River, Wis., 3712; operating and care of locks and dams on Fox River, Wis., 3721.

EXAMINATIONS AND SURVEYS.—Menominee River, Mich. and Wis., 3739; harbor at Oconto, Wis., 3745; Green Bay Harbor, Wis., 3747; harbor at Kewaunee, Wis., 3752; harbor at Two Rivers, Wis., 3759; Manitowoc Harbor, Wis., 3761; harbor at Port Washington, Wis., 3766; harbor at Kenosha, Wis., 3767; Waukegan Harbor, Ill., 3769.

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APPENDIX M M.

REPORT OF MAJ. J. H. WILLARD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chicago Harbor, Ill., 3779; Chicago River, Ill., 3784; Calumet Harbor, Ill., 3788; Calumet River, Ill. and Ind., 3792; Illinois River, Ill., 3798; operating and care of Lagrange and Kampsville Locks and Dams, Illinois River, 3805; Illinois and Mississippi Canal, 3810; operating and care of Illinois and Mississippi Canal (canal around lower rapids of Rock River, Ill.), 3853.

EXAMINATION AND SURVEY.—Upper Illinois and Lower Des Plaines rivers, Ill., 3855; Chicago River, Ill., 3863.

APPENDIX N N.

REPORT OF CAPT. CHESTER HARDING, CORPS OF ENGINEERS.

IMPROVEMENTS.—Michigan City Harbor, Ind., 3873; St. Joseph Harbor, Mich., 3879; St. Joseph River, Mich., 3883; South Haven Harbor, Mich., 3884; Saugatuck Harbor, Mich., 3887; Kalamazoo River, Mich., 3890; Holland (Black Lake) Harbor, Mich., 3891; Grand Haven Harbor, Mich., 3895; Grand River, Mich., 3899; Muskegon Harbor, Mich., 3905; White Lake Harbor, Mich., 3909; Pentwater Harbor, Mich., 3913; Ludington Harbor, Mich., 3916; Manistee Harbor, Mich., 3919; harbor of refuge at Portage Lake, Manistee County, Mich., 3922; Frankfort Harbor, Mich., 3925; Charlevoix Harbor, Mich., 3928; Petoskey Harbor, Mich., 3932; removing sunken vessels or craft obstructing or endangering navigation, 3933.

EXAMINATIONS.—Muskegon River, Mich., 3934; channel from Lake Michigan to Stony Lake, Mich., 3939; Arcadia, Mich., 3942.

PART VI.

APPENDIX O O.

REPORT OF LIEUT. COL. G. J. LYDECKER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ship canal connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, 3947; St. Marys River at the Falls, Mich., 3952; operating and care of St. Marys Falls Canal, Mich., 3956; Hay Lake Channel, St. Marys River, Mich., 3969; Cheboygan Harbor, Mich., 3973; Alpena Harbor (Thunder Bay River), Mich., 3975; Saginaw River, Mich., 3978; Sebewaing River, Mich., 3981; harbor of refuge at Sandbeach, Lake Huron, Mich., 3983; mouth of Black River, Mich., 3986; Black River at Port Huron, Mich., 3987; Pine River, Mich., 3989; Belle River, Mich., 3991; St. Clair Flats Canal, Mich., 3993; operating and care of St. Clair Flats Canal, Mich., 3994; Clinton River, Mich., 3996; Detroit River, Mich., 3997; Rouge River, Mich., 4006.

EXAMINATIONS AND SURVEYS.—Mackinac Harbor, Mich., 4008: Cheboygan Harbor, Mich., 4012; Detroit River, Mich., 4015.

APPENDIX P P.

REPORT OF COL. JARED A. SMITH, CORPS OF ENGINEERS.

IMPROVEMENTS.—Monroe Harbor, Mich., 4019; Toledo Harbor, Ohio, 4022; Port Clinton Harbor, Ohio, 4038; Sandusky Harbor, Ohio, 4042; Huron Harbor, Ohio, 4051; Black River (Lorain) Harbor, Ohio, 4054; Cleveland Harbor, Ohio, 4063; Fairport Harbor, Ohio, 4070; Ashtabula Harbor, Ohio, 4075; breakwater construction at harbors on Lake Erie, 4084; Conneaut Harbor, Ohio, 4091; removing sunken vessels or craft obstructing or endangering navigation, 4094.

APPENDIX Q Q.

REPORT OF MAJ. T. W. SYMONS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Erie Harbor, Pa., 4099; harbor at Dunkirk, N. Y., 4108; Buffalo Harbor, N. Y., 4113; Buffalo entrance to Erie Basin and Black Rock Harbor, N. Y., 4135; Tonawanda Harbor and Niagara River, N. Y., 4138; Niagara River from Tonawanda to Port Day, N. Y., 4144.

EXAMINATIONS AND SURVEY.—Dunkirk Harbor, N. Y., 4148; Tonawanda Harbor and Creek, N. Y., 4152.

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APPENDIX R R.

REPORT OF CAPT. GRAHAM D. FITCH, CORPS OF ENGINEERS.

IMPROVEMENTS.—Wilson Harbor, N. Y., 4161; harbor at Charlotte, N. Y., 4163; harbor at Pultneyville, N. Y., 4165; harbor at Great Sodus Bay, N. Y., 4166; harbor at Little Sodus Bay, N. Y., 4168; Oswego Harbor, N. Y., 4170; harbor at Cape Vincent, N. Y., 4173; shoals in the St. Lawrence River between Ogdensburg and foot of Lake Ontario, 4175; Ogdensburg Harbor, N. Y., 4177; removing sunken vessels or craft obstructing or endangering navigation, 4180.

APPENDIX S S.

REPORT OF CAPT. JAMES J. MEYLER, CORPS OF ENGINEERS.

IMPROVEMENTS.—San Diego Harbor, Cal., 4181; deep-water harbor at San Pedro Bay, Cal., 4187; Wilmington Harbor, Cal., 4191; San Luis Obispo Harbor, Cal., 4192.

EXAMINATION AND SURVEY.—Inner harbor, San Pedro Harbor, Cal., 4194.

APPENDIX T T.

REPORT OF LIEUT. COL. WM. H. HEUER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Alviso Harbor, Cal., 4213; San Francisco Harbor, Cal., 4215; Oakland Harbor, Cal., 4218; San Joaquin River, Cal., 4223; Mokelumne River, Cal., 4226; Sacramento and Feather rivers, Cal., 4227; Sacramento River, Cal., from Sacramento to the mouth, 4230; Napa River, Cal., 4234; Petaluna Creek, Cal., 4236; Humboldt Harbor and Bay, Cal., 4237.

EXAMINATIONS.—Harbor at South San Francisco, Cal., 4248; Suisun Creek, Cal., 4250; Napa River, Cal., 4253; Sonoma Creek, Cal., 4256; channel between Straits of Karquines and the Golden Gate, Cal., 4258; Crescent Bay (Crescent City Harbor), Cal., 4262.

APPENDIX U U.

REPORT OF CAPT. WM. W. HARTS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Port Orford Harbor, Oreg., 4265; Coquille River, Oreg., 4266; Coquille River, Oreg., between Coquille and Myrtle Point, 4271; entrance to Coos Bay and Harbor, Oreg., 4274; Coos Bay, Oreg., 4280; Coos River, Oreg., 4283; Siuslaw River, Oreg., 4286; Yaquina Bay, Oreg., 4291; examination Yaquina Bay, Oreg., 4293; Tillamook Bay and Bar, Oreg., 4314; Upper Columbia and Snake rivers, Oreg. and Wash., 4319; Columbia River at Three-mile Rapids and boat railway from The Dalles Rapids to Celilo Falls, 4322; canal at the Cascades, Columbia River, Oreg., 4324; operating and care of canal and locks at the Cascades, Columbia River, 4329; Columbia River between Vancouver, Wash., and mouth of Willamette River, 4334; Clearwater River, Idaho, 4337.

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APPENDIX V V.

REPORT OF CAPT. W. C. LANGFITT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Long Tom River, Oreg., 4346; Willamette River above Portland, and Yamhill River, Oreg., 4347; Columbia and Lower Willamette rivers below Portland, Oreg., 4352; Columbia River, Oreg., below Tongue Point, 4360; mouth of Columbia River, Oreg. and Wash., 4361; Clatskanie River, Oreg., 4363; Lewis River, Wash., 4364; Cowlitz River, Wash., 4366; gauging Columbia River, Oreg. and Wash., 4368.

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ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY.

1900.

REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

Office of the Chief of Engineers,
United States Army,
Washington, September 28, 1900.

Sir: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1900:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, United States Army, at the end of the fiscal year was 126.

Since the last Annual Report the Corps of Engineers has lost four of its officers: Lieut. Col. William H. H. Benyaurd, who died February 7, 1900; Lieut. Col. William Ludlow, who was appointed brigadier-general, United States Army, January 21, 1900; Maj. Frederick A. Mahan, who was retired from active service April 2, 1900, and Capt. Oberlin M. Carter, who was dismissed the service September 29, 1899.

There were added to the Corps of Engineers, by promotion of graduates of the Military Academy, two second lieutenants and three additional second lieutenants on June 26, 1900, to date from June 13, 1900.

The organization of the Corps of Engineers as now fixed by law (act of July 5, 1898) provides for 127 officers and a battalion of engineers of five companies of 150 enlisted men each. The increasing demands for engineer officers and troops to meet the requirements of military service in the new possessions of the United States, coupled with the necessity of keeping up the increasing number of public engineering works assigned to the Corps of Engineers by law, render an increase in the number of engineer officers and troops an urgent necessity. During the past year frequent requests have been received for the detail of additional engineer officers to serve in the various military departments, of which only the most pressing could be met.

At the close of the fiscal year 14 officers of the Corps of Engineers and two companies of the engineer battalion were on duty in or en route to the Philippines, China, Cuba, and Porto Rico, and shortly after the close of the year orders were issued sending two more officers and an additional company for service in China. The duties of the engineer officers and troops in the island possessions have consisted in map making, repairing and construction of roads, railroads, and bridges, sanitary and municipal engineering, and duty at outposts and on the firing line. These duties have been most exacting and have been creditably performed.

There seems to be no prospect of any diminution of the future work of the Corps of Engineers, and an increase in the number of its officers is earnestly recommended to the favorable consideration of Congress.

On the 30th of June, 1900, the officers were distributed as follows:

Commanding the Corps of Engineers and Engineer Department	1
Office of the Chief of Engineers and Light-House Board	1
Office of the Chief of Engineers	3
Division Engineer, Board of Engineers, Board of Visitors to United States Engineer School	1
Division Engineer, Board of Engineers, fortifications, and river and harbor works.	1
Division Engineer and Isthmian Canal Commission	1
Division Engineer, Board of Engineers, Mississippi River Commission, and Light-House Board	1
Fortifications and river and harbor works	31
River and harbor works	15
Division Engineer and California Débris Commission	1
Mississippi River Commission, Missouri River Commission, and light-house district	1
Fortifications, river and harbor works, and Isthmian Canal Commission	1
Washington Aqueduct	2
Fortifications, river and harbor works, and California Débris Commission	1
Mississippi River Commission, Missouri River Commission, and light-house district	1
Fortifications and light-house district	1
Post of Fort Totten, United States Engineer School, and Battalion of Engineers.	8
Missouri River Commission, fortifications, and river and harbor works	1
River and harbor works and light-house districts	3
Mississippi River Commission	3
Public buildings and grounds	1
Light-house duty	1
Fortifications, river and harbor works, and light-house district	1
River and harbor works, Yellowstone National Park, and Fort Washakie military road	1
Changing station	3
Mississippi River Commission and light-house district	1
Board of Engineers	1
Missouri River Commission	1
California Débris Commission	1
Building for Government Printing Office	1
Leave of absence	4
Graduating leave of absence	5
Detached, with Light-house Establishment, as military attaché to United States legations, with military divisions and departments, at the Military Academy, to International Congresses of Navigation and Electricity, and with Commissioners of the District of Columbia	27
Total	126

The officers detached were on duty as follows:

Lieut. Col. David P. Heap, engineer Third light-house district	1
Lieut. Col. William A. Jones, engineer Fourth and Fifth light-house districts	1
Lieut. Col. Andrew N. Damrell, engineer Seventh and Eighth light-house districts	1
Lieut. Col. William R. Livermore, military attaché to the United States legations at Copenhagen and Stockholm	1
Lieut. Col. William S. Stanton, engineer First and Second light-house districts	1
Maj. Richard L. Hoxie, engineer secretary of the Light-House Board	1
Maj. William M. Black, engineer officer, Division of Cuba	1

Maj. George W. Goethals and First Lieuts. Jay J. Morrow and Edwin R. Stuart, on duty at the United States Military Academy	3
Maj. John Millis, to attend the Eighth International Congress of Navigation and the International Congress of Electricity, at Paris, France	1
Capt. John Biddle, engineer officer, Division of the Philippines	1
Capt. Lansing H. Beach, Engineer Commissioner of the District of Columbia	1
Capts. David DuB. Gaillard and Henry C. Newcomer, assistants to the Engineer Commissioner of the District of Columbia	2
Capt. William E. Craighill, major, Fortieth Infantry, U. S. Volunteers	1
Capt. William V. Judson, engineer officer, Department of Porto Rico	1
First Lieut. James P. Jervey, on duty at the United States Military Academy and in temporary command of Company E, Battalion of Engineers	1
First Lieut. William J. Barden, engineer officer, Department of Matanzas and Santa Clara	1
First Lieuts. Harry Burgess and Frederick W. Altstaetter, and Second Lieuts. Lytle Brown and William Kelly, for duty in the Division of the Philippines	4
First Lieut. John C. Oakes, engineer officer, Department of Southern Luzon	1
First Lieut. Sherwood A. Cheney, assistant engineer officer, Division of the Philippines	1
First Lieut. Harley B. Ferguson and Second Lieut. Horton W. Stickle, with Battalion of Engineers, Division of the Philippines	2
Total	27

THE BOARD OF ENGINEERS.

The regulations for the government of the Corps of Engineers provide for a Board of Engineers, consisting of not less than three officers, to be designated by the Chief of Engineers with the sanction of the Secretary of War. This Board acts in an advisory capacity to the Chief of Engineers upon important questions of engineering. One of the principal duties of the Board is to plan or revise, under direction of the Chief of Engineers, projects of permanent fortifications for the defense of the United States.

The composition of this Board and its operations during the past fiscal year are given in its report.

(See Appendix No. 1.)

BOARD ON TORPEDO SYSTEM.

The Board for the consideration of the existing torpedo system has continued the study of this system, especially in the light of reports submitted by officers of the Corps of Engineers in charge of submarine-mine defenses during the Spanish-American war.

Changes in minor details only have so far been proposed.

To this Board have been referred for examination and report descriptions submitted to this office of inventions connected with submarine-mine defenses.

(See Appendix No. 2.)

FORTIFICATIONS.

The scheme of national defense upon which work has now been in progress since 1888 is based upon the recommendations of the Board on Fortifications and other Defenses, popularly known as the Endicott Board, outlined in its report dated January 16, 1886. This Board indicated the localities where defenses were most urgently needed, the character and general extent of the defenses, and the estimated cost, and recommended for first consideration the names of 27 principal ports, arranged in the order of their importance. At the time of its report the coasts of the United States were undefended, except by obsolete ordnance mounted in old-style masonry forts entirely incapable of coping with ships protected by armor and armed with powerful breech-loading cannon, such as had been uniformly adopted for the fleets of the world. Moreover, the manufacture of modern seacoast guns and carriages in the United States had not yet been entered upon or designs therefor perfected.

The first fortification appropriation act designed to carry out the recommendations of the Endicott Board was approved September 22, 1888. This act created the Board of Ordnance and Fortification and made appropriations for commencing the manufacture of modern seacoast ordnance, but made no provision for the construction of any batteries. The first appropriation for the construction of gun and mortar batteries was contained in the act of August 18, 1890, since which time appropriations of varying amounts have been made regularly each year for carrying forward the adopted scheme of coast defense—for the manufacture of ordnance, for the construction of batteries, and for the necessary torpedo defenses.

The defensive details for each locality have been carefully elaborated from time to time by the Board of Engineers in projects which have received the formal approval of the Secretary of War prior to the actual beginning of any work. Up to the present time projects for permanent seacoast defenses have been adopted for 30 localities in the United States, as follows:

1. Penobscot River, Maine.
2. Kennebec River, Maine.
3. Portland, Me.
4. Portsmouth, N. H.
5. Boston, Mass.
6. New Bedford, Mass.
7. Narragansett Bay, Rhode Island.
8. Eastern entrance to Long Island Sound.
9. New York, N. Y.
10. Philadelphia, Pa.
11. Baltimore, Md.
12. Washington, D. C.
13. Hampton Roads, Virginia.
14. Wilmington, N. C.
15. Charleston, S. C.
16. Port Royal, S. C.
17. Savannah, Ga.
18. St. Johns River, Florida.
19. Key West, Fla.
20. Tampa Bay, Florida.
21. Pensacola, Fla.
22. Mobile, Ala.
23. New Orleans, La.
24. Sabine Pass, Tex.
25. Galveston, Tex.
26. San Diego, Cal.
27. San Francisco, Cal.
28. Mouth of Columbia River, Oregon and Washington.
29. Puget Sound, Washington.
30. Lake Champlain.

No formal projects for the defense of additional localities were approved during the fiscal year, and the list above given is the same as that contained in the previous Annual Report. A preliminary project for the defense of the entrance to Chesapeake Bay at Cape Henry, Virginia, was approved by the Secretary of War, and the preparation of a detailed project was in progress at the close of the fiscal year. The defense of several additional localities in the United States is also under consideration, for which no formal projects have yet been prepared or approved by the Secretary of War.

Considerable study has also been given to the subject of seacoast defenses for Porto Rico and the Hawaiian Islands, and, in view of the importance of these island possessions, active measures for their defense should no longer be delaved. A detailed project for the defense of San Juan, Porto Rico, at a total estimated cost of $1,800,000, has already been prepared, and preliminary projects for Pearl Harbor and Honolulu, Hawaiian Islands, are also available, and the work of construction can be commenced whenever Congress appropriates the necessary funds.

Of the existing projects for the United States, as enumerated above, many have from time to time been revised to keep pace with the changes in ordnance and in ships' armament and construction. Nearly fifteen years have elapsed since the adopted scheme of coast defense was formulated by the Endicott Board. At that time the rapid-fire gun was in its infancy and ships were characterized by their extremely heavy armament and great thickness of armor. With the rapid development of the rapid-fire gun and the increase in the resisting powers of armor by means of the Harvey and Krupp processes, there has followed a material change in ship construction, necessitating corresponding changes in the details of coast defenses. In accordance with the recommendations of the Endicott Board, the earlier detailed projects contemplated mounting a considerable number of the heaviest guns at the more important harbors in armored works. The tendency toward a reduction in calibers of heavy guns, coupled with the adoption of a successful disappearing carriage for the 12-inch gun, has rendered armored defenses unnecessary up to the present time, and the United States has thus far not embarked upon the construction of armored casemates and turrets, to which many European governments stand committed for their land defenses. Although rapid-fire guns were proposed in the earlier projects, no definite numbers or calibers were assigned until 1896, since which time nearly all of the earlier projects have been subjected to one or more revisions, resulting in the incorporation of a definite programme as to the rapid-fire armament, a reduction in the number and caliber of the heavy guns, a reduction in the number of mortars, and the general elimination of armored defenses. These revisions have resulted in marked economies without any sacrifice to the defensive requirements, and they will be continued as changes in ordnance and ships or other causes may render desirable.

The inauguration of the modern system of seacoast defenses for the United States dates practically from the year 1890, when the first appropriation for constructing gun and mortar batteries was made. It was not, however, until the year 1896, and subsequently, that appropriations commensurate with the magnitude of the undertaking were made. Stimulated by the larger appropriations of more recent years and the war with Spain, the seacoast defenses of the United States are to-day, ten years after the actual commencement of work, about 50 per cent completed. Twenty-five of the principal harbors of the United States have now a sufficient number of heavy guns and mortars mounted to permit of an effective defense against naval attack. During the past fiscal year considerable progress has also been made toward the installation of an adequate rapid-fire armament, which is now a matter of first importance.

Gun and mortar batteries.—Existing approved projects for seacoast defenses contemplate the mounting of about 480 heavy guns of 8, 10, 12, and 16 inch caliber, of about 850 rapid-fire guns from 6-pounder to 6-inch caliber, and of about 900 mortars, at an approximate total cost for the engineering work now estimated at $50,000,000.

The several appropriations made by Congress for the construction of gun and mortar batteries since the inauguration of the present system of coast defense have been as follows:

Act of—	
August 18, 1890	$1,221,000.00
February 24, 1891	750,000.00
July 23, 1892	500,000.00
February 18, 1893	50,000.00
August 1, 1894	500,000.00
March 2, 1895	500,000.00
June 6, 1896	2,400,000.00
March 3, 1897	3,841,333.00
Allotments from the appropriation for "National Defense," act of March 9, 1898	$3,817,879.62
May 7, 1898	3,000,000.00
July 7, 1898	2,562,000.00
March 3, 1899	1,000,000.00
May 25, 1900	2,000,000.00
Total	22,142,212.62

The foregoing does not include $306,805.04 allotted and expended from the appropriation for "National Defense" for the construction, during the war with Spain, of a number of emergency sand batteries on the Atlantic and Gulf coasts, and which have since been abandoned, they not forming any part of the approved scheme of permanent defenses and having been armed chiefly with old-type obsolete ordnance.

The total number of seacoast guns and carriages for which the Chief of Ordnance reports his Department has made provision, and the corresponding permanent emplacements for which the Engineer Department has made provision with the funds appropriated for construction of gun and mortar batteries, including allotments from the appropriation for "National Defense," are shown in the following table:

Type of gun or carriage.	Total guns and carriages provided.	Total emplacements provided.
12-inch mortar carriages, model 1896	288	288
12-inch mortar carriages, model 1891	85	84
12-inch disappearing carriages, L. F., model 1897	35	85
12-inch disappearing carriages, L. F., model 1896	27	27
10-inch disappearing carriages, A. R. F., model 1896	3	3
10-inch disappearing carriages, L. F., model 1896	74	74
10-inch disappearing carriages, L. F., model 1894	35	85
8-inch disappearing carriages, L. F., model 1896	88	88
8-inch disappearing carriages, L. F., model 1894	26	26
12-inch gun-lift carriages, altered to barbettes	8	8
12-inch gun-lift carriages, model 1891	2	2
12-inch barbette carriages, model 1892	26	26
10-inch barbette carriages, model 1893	10	*a* 10
15-inch smoothbore carriages altered for 8-inch rifle	21	*b* 21
8-inch barbette carriages, model 1892	10	*c* 9
6-inch disappearing carriages, model 1897	29	29
6-inch rapid-fire pedestal mount, U. S. Ordnance Department	20	20
15-pounder rapid-fire carriages	120	120
6-pounder rapid-fire field carriages and rampart mount	70	(*d*)
6-inch rapid-fire carriages (navy pattern, for Brown wire gun)	25	25
6-inch rapid-fire (Vickers Son & Maxim), pedestal mount	8	8
5-inch barbette carriages, on pillar mount, model 1896	32	32
5-inch rapid-fire (navy pattern, Brown wire gun)	25	25
4.7-inch rapid-fire (Armstrong pattern), pedestal mount	35	35
4-inch Driggs-Schroeder rapid-fire	4	4

a 1 temporary. *b* Temporary. *c* 5 temporary. *d* Movable mounts.

The foregoing table shows that up to the present time provision has been made for emplacing 309 heavy guns, 368 rapid-fire guns, and 372 12-inch mortars.

During the fiscal year just closed operations were carried on with unexpended balances of the appropriations carried by the regular fortification appropriation acts approved May 7, 1898, and March 3, 1899, and the deficiency act approved July 7, 1898. The number of emplacements of each kind provided for under each of the foregoing acts is exhibited in previous Annual Reports. Under the fortification act of May 25, 1900, it is proposed to provide emplacements for the following number of guns and mortars:

12-inch.	10-inch.	6-inch rapid-fire.	12-inch mortars.
8	4	20	[a]28

[a] May be increased to 32, provided funds available will permit.

The total number of emplacements of every kind provided for by all appropriations to date is as follows:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
93	122	94	368	372

In this total are included seventy 6-pounder rapid-fire guns on movable mounts not requiring permanent emplacements, temporary emplacements for twenty-one 8-inch B. L. rifles on modified 15-inch carriages, one temporary emplacement for 10-inch gun on barbette carriage, and five temporary emplacements for 8-inch guns on barbette carriages. The foregoing temporary emplacements were built during the war with Spain from the "National Defense" funds. Their armament will be transferred from time to time to permanent emplacements as these are completed, and a number of the 8-inch guns have already been so transferred. While it is proposed eventually to disarm these temporary emplacements, they can again be used in case of emergency, and have for this reason been included in the foregoing enumerations.

The deficiency act of July 7, 1898, provides funds for mounting 25 each of 5-inch and 6-inch Brown segmental wire-wound rapid-fire guns on navy-pattern mounts. Although considerable delay was experienced in securing the necessary data from the Chief of Ordnance, the emplacements for the 5-inch guns are now either completed or under construction. No guns or mounts have yet been delivered The required information relating to the 6-inch guns has not yet been furnished, notwithstanding that over two years have elapsed since the contract for manufacture of these guns was made. It is understood that the contractors alone are responsible for this state of affairs. The status of emplacements for which funds have been provided by Congress is as follows at the close of the fiscal year:

	12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
Guns mounted	57	105	[a]75	53	240
Ready for armament	23	8	16	[b]189	84
Under construction	13	9	3	81	48
Not yet begun	....	....	....	45	....
Total	93	122	94	368	372

[a] Ten of these, which had been mounted temporarily, have since been dismounted.
[b] Including seventy 6-pounders not requiring permanent emplacements.

At the close of the previous fiscal year there were reported mounted:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
27	83	59	46	176

A comparison of the last two tables shows an addition to the completed seacoast armament of thirty 12-inch guns, twenty-two 10-inch guns, sixteen 8-inch guns, seven rapid-fire guns, and sixty-four mortars.

Reference was made in previous Annual Report to the completion of all contract works authorized under act of June 6, 1896, except the contract of the Venable Construction Company, of Atlanta, Ga., for the construction of a gun and a mortar battery at Key West, Fla. Although the contractors did more or less work during the year, except during the period of a yellow-fever outbreak, the results accomplished were incommensurate with the magnitude of the work, and shortly after the close of the fiscal year, after the date of completion had been extended nine times, the contractors abandoned work.

Attention is again invited to the urgent necessity for an increase of the artillery arm of the service. The number of completed batteries transferred to the troops for use and care under the provisions of Army Regulations 1486 was largely increased during the past fiscal year, and this number will be still further increased by the number of batteries in progress of construction and soon to be completed. The ordnance and the mechanical and electrical appliances of the new batteries require for their proper maintenance a degree of care and attention unknown in the case of the old-type works, and which it is almost impossible to realize from the small available force of artillery scattered in small detachments over our extensive seaboard.

For continuing the work of construction of gun and mortar batteries in accordance with approved projects an estimate of $4,560,000 is submitted, of which sum $200,000 is intended for the construction of defenses at San Juan, Porto Rico.

Dynamite batteries.—The act of May 25, 1900, appropriates the sum of $180,000 for pneumatic dynamite batteries. This appropriation is based upon estimates for the construction of magazines and protecting parapets for the existing dynamite battery at Sandy Hook and for those under construction by contract with the Ordnance Department at Fishers Island, New York, and Port Royal, S. C. The contracts with the Ordnance Department under which the several dynamite batteries in the United States were constructed did not provide for the erection of any protecting parapets or of any magazines for the safe storage of the ammunition, and the object of the appropriation is to supply these omissions, without which the batteries could not be served in an engagement. Work has already been begun upon the battery at Sandy Hook, and the preparation of the plans for the other localities was in progress at the close of the fiscal year.

Range and position finders.—During the fiscal year operations were continued in the installation of range and position finders as required by the approved plans of fire control prepared by an artillery board. The act of May 25, 1900, apppropriates $150,000 for this purpose, with which it is proposed to construct about 25 additional range-finder stations, for which plans and estimates had been ordered before the close of the fiscal year. With stations previously constructed, there will be about 55 main stations available for use out of a total projected number of 177 required for batteries completed and building. Many details of the fire-control system do not yet appear to have been definitely settled, especially the question as to the use of depression position finders upon artificial elevations on low sites, as contemplated by the present approved plans of fire control, and to which considerable objection has been made, an objection which is shared in by the Engineer Department. To enable the Engineer Department to continue its share of the work of installing range and position finders an estimate of $150,000 is submitted.

Preservation and repair of fortifications.—Operations under this appropriation have been limited during the fiscal year mainly to the preservation of the engineer material in the new batteries, to the application of remedial measures for improving the conditions of the magazines of the earlier works as regards dampness, and to the care and preservation of the torpedo material stored at each harbor. The mechanical and electrical appliances in the modern batteries demand unremitting attention to prevent deterioration and damage under the destructive influences of the moist sea air, and the limited annual appropriations for preservation and repair of fortifications barely suffice to meet the numerous needs of the ever-increasing number of batteries. The new works already constructed represent an expenditure of approximately $20,000,000 for the engineering work alone, for which an annual appropriation of $100,000, one-half of 1 per cent of the cost of the works, is made for preservation and repair. The usual annual estimate of $100,000 is submitted, to provide for works of preservation and repair during the ensuing year.

Supplies for seacoast defenses.—The act of May 25, 1900, appropriates the sum of $25,000 for tools and electrical and engine supplies for use of the troops for maintaining and operating light and power plants in gun and mortar batteries. This is the first appropriation made for this purpose and is designed to enable the Engineer Department to meet the requirements of General Orders, No. 66, Adjutant-General's Office, 1900, prescribing the sources of supply by the staff departments of the various classes of articles required by the coast artillery for the service of the batteries. A special blank form of requisition for the use of acting engineer officers at artillery posts has been prepared and was issued at the close of the fiscal year. Requisitions are made directly upon the Chief of Engineers, and authorized articles are purchased and issued by the district engineer officers with as little delay as possible. It is expected that this system will prove satisfactory, and that so far as the Engineer Department is concerned, the artillery will have no cause for complaint in delays in receiving needed supplies. An estimate of $25,000 is submitted for the same purpose for the next fiscal year.

Sea walls and embankments.—The act of May 25, 1900, appropriates $50,000 for the general construction of sea walls and embankments, and $150,000 specifically for a sea wall and filling in at Fort Caswell, N. C. The former appropriation will be applied to the construction of sea walls at Fort Schuyler, N. Y., Fort Monroe, Va., Fort Smallwood, Md., and Gardiners Point, N. Y., at all of which points protective works are urgently required for the preservation of defensive works against encroachment by the sea. At the close of the fiscal year projects for these works had been approved or were in progress of preparation, and it is expected that the various sea walls will be completed during the present working season. The appropriation of $150,000 for a sea wall and filling in at Fort Caswell, N. C., was based upon a special estimate to Congress as a result of an extraordinary storm tide on September 30, 1899, which broke over the reservation and did serious damage to the buildings and batteries. At the close of the fiscal year the project for this work had been approved and preparations for its commencement were well under way.

Based upon reports of district engineer officers, showing the necessity for their construction, an estimate of $155,000 is submitted for the construction of sea walls and embankments at a number of localities.

Sites.—During the past year negotiations have been continued under acts prior to that of May 25, 1900, for the acquisition of sites in Boston Harbor (two sites), Narragansett Bay (two sites), New York Harbor (extension of Fort Wadsworth, two tracts), Port Royal, S. C., San Francisco Harbor, and at Rich Passage, Puget Sound. With few exceptions these sites must, from various causes, be acquired by condemnation proceedings, which are slow and tedious. The acquisition of the needed sites at Rich Passage, Puget Sound, was completed and title is now vested in the United States. All the remaining tracts above named are still under negotiation and in various stages of progress. With the appropriation of $200,000 contained in the act of May 25, 1900, arrangements for the purchase of a tract adjoining the Fort Wadsworth reservation have been completed, and the title was under examination by the Department of Justice at the close of the fiscal year. The remainder of the appropriation will be applied as far as possible to the purchase of sites still required at Narrangansett Bay, eastern entrance to New York Harbor, St. Johns River, Florida, and Sabine Pass, Tex.

A number of sites still remain to be acquired to carry out the approved projects of seacoast defenses, and an estimate of $500,000 is submitted to continue the work. The most important of the sites still to be acquired are one in Boston Harbor, the property of the city, and one at the southern entrance to New York Harbor, rendered necessary by the proposed new deep-water entrance now under construction.

Submarine mines.—During the fiscal year special efforts have been directed toward fully equipping all harbors with a full complement of torpedo material to render available for service all the mines and cable already on hand. This required the purchase and issue of a vast amount of minor accessory articles through the Engineer Depot. As a preliminary measure, carefully prepared detailed lists were required from each district engineer officer, showing exactly all articles on hand, all articles still needed to complete the equipment of mines and cable in store, and the condition of the available material. With these lists as a guide the purchase and issue of needed material has progressed partly under the appropriation in the act of March 3, 1899, and partly under the appropriation act of May 25, 1900. It is expected that all required torpedo material to enable a quick and effective defense to be made will be in store at each harbor before the close of the calendar year. The appropriation of $50,000 contained in the act of May 25, 1900, will be applied in part to the purchase of torpedo material, as above stated, and in part to the construction of storage facilities and mining casemates. With few exceptions, all harbors are now equipped with torpedo storehouses, cable tanks, mining casemates, and a good supply of torpedo material, which is kept in good condition by thorough and detailed semiannual inspections. Torpedo experiments with a view to improvements in the adopted system have been carried on at the United States Engineer School and elsewhere, and such experiments, as well as inventions or ideas submitted by individuals, are considered by a Board of Engineer Officers, known as the Board on the Torpedo System.

Mining casemates and additional storage facilities are still required at several localities, and the equipment of searchlights should also be increased. For these purposes and for the continuation of torpedo experiments, an estimate of $100,000 is submitted.

The following brief summaries of the detailed reports of district officers give a concise statement of the work at each locality during the fiscal year.

Defensive works on coast of Maine.—Officer in charge, Maj. S. W. Roessler, Corps of Engineers; assistants, Lieut. (now Captain) Charles Keller, Corps of Engineers until September 30, 1899, and Lieut. Thomas H. Jackson, Corps of Engineers, for the entire year; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

Bar Harbor, Maine.—Two 8-inch converted rifles and two 10-inch smoothbore guns were mounted on temporary wooden platforms for the defense of this point during the war with Spain in 1898. No repairs have been made during the year.

Penobscot River, Maine.—A growth of brushwood has developed on the terreplein north of the fort proper, and was cut down several years ago. Having again grown to considerable height, it was again cut down this year. The ordnance storeroom has been repaired, and some minor repairs have been made to the quarters of the ordnance sergeant. No work has been done on the armament, which was thoroughly overhauled in the preceding fiscal year.

Kennebec River, Maine.—Four 15-inch smoothbore guns were mounted for the temporary defense of the river during the war with Spain in 1898. These have been dismounted and stored, platforms taken up, and the ground leveled off. The present armament consists of one 8-inch B. L. rifle on a strengthened 15-inch smoothbore barbette carriage.

Portland Harbor, Maine.—During the fiscal year work in constructing new fortifications has been in progress on three 8-inch batteries, two 12-inch batteries, one 10-inch battery, two mortar batteries, one 6-inch battery, and two 15-pounder batteries. Repairs were in progress on two 10-inch batteries.

At the beginning of the year, two of the 8-inch batteries had had their sites and roadway nearly excavated and the concrete brought up to the level of the loading platform, and the site of one emplacement on the third 8-inch battery had been excavated and the concreting nearly completed. During the fiscal year just closed, one of these batteries has been completed except the erection of hand rails, mounting of guns, and removal of plant; the second battery has also been well advanced and is now complete except the placing of a portion of the fill, the erection of hand rails, and removal of plant. At the third 8-inch battery the emplacement commenced the previous year has been completed except as to roadway, a second emplacement has been excavated and the concreting finished, and the site of a third emplacement has been excavated and the concreting commenced.

One of the 12-inch batteries was well advanced at the beginning of the year, and on June 30, 1900, required only the macadamizing of the roadway and the erection of hand rails to complete, ready for transfer to the artillery.

On the second 12-inch battery the excavation for one emplacement, on date of last Annual Report, had been nearly completed, main drain nearly completed, and the excavation for a second emplacement advanced about 75 per cent. At the close of the year all drains had been laid, excavations completed on both emplacements, and that for a third gun also nearly completed, and the concrete on the first emplacement raised to above platform level.

Excavation on the site of the 10-inch battery was nearly completed at the date of last report. This and the laying of the drains have been completed during the year and about 2,500 cubic yards of concrete has been placed. The work heretofore commenced on the first mortar battery, to remove certain defects and to complete, was continued. The floors in the magazines and shell rooms were raised, properly sloped, and provided with drains which connect with the main drain. Under an allotment of $19,000, additional work, which will include finishing of floors in pits, erection of retaining walls to obliterate crumbling rock faces in the pits, grading and macadamizing roads, and completion of parapet, was commenced in June, 1900.

At the second mortar battery, the only work done at the beginning of the fiscal year was the laying of a portion of a deep-laid drain or sewer. During the year this drain was completed, branch drains laid, excavation for whole battery practically completed, plant erected, concreting commenced, and about two-thirds of walls and covering the east traverse completed.

During the year ground was broken for one battery of 6-inch guns and two batteries of two 15-pounder rapid-fire guns. At the end of the year practically all the excavation for the 6-inch battery and roadway had been completed, and the walls of one emplacement commenced. All the excavation had been practically completed on one of the 15-pounder batteries, and on the second the excavation had all been completed, drains laid, floors nearly all laid, and concreting on walls begun.

Additional work has been done as follows: Floors raised in magazines and passageways, ventilators placed in magazines and shell rooms of 10-inch gun batteries, road in rear of battery lowered, graded, and macadamized, open brick drains and two catch-basins constructed, concrete retaining wall built, and automatic locking device attached to lifts.

Two position finders have been erected, and four others authorized.

No work has been done during the fiscal year on the older type fortifications in this harbor, except such small repairs as have been necessary from time to time.

(See Appendix 3 A.)

Defenses of Portsmouth, N. H.—Officers in charge, Maj. Solomon W. Roessler, Corps of Engineers, until September 30, 1899, and Maj. Walter L. Fisk, Corps of Engineers, since that date; assistants, Lieut.

Thomas H. Jackson, Corps of Engineers, until September 30, 1899, and Lieut. (now Captain) Charles Keller, Corps of Engineers, until November 15, 1899; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

At the beginning of the fiscal year a battery of two 8-inch B. L. rifles on disappearing carriages had been completed, with the exception of the electric-lighting plant, and turned over to the troops. A mining casemate was also constructed in connection with this battery.

Considerable preparatory work had also been done on a battery for three 10-inch B. L. rifles on disappearing carriages, temporary buildings erected, some plant collected, and a wooden wharf built.

During the fiscal year the erection of all necessary plant and the earth and rock excavation for the battery have been completed, and concrete construction is well under way.

The two 8-inch B. L. rifles, which at the beginning of the fiscal year were mounted on strengthened 15-inch smoothbore carriages, have since been dismounted and shipped elsewhere by the Quartermaster's Department for use on disappearing carriages.

A cable tank has been built during the fiscal year, and minor repairs have been made from time to time as needed on batteries and buildings, and the torpedo material has been overhauled and cleaned.

(See Appendix 3 B.)

Defenses of Boston, Mass.—Officer in charge, Col. Charles R. Suter, Corps of Engineers; assistants, Lieut. Charles S. Bromwell, Corps of Engineers, until April 5, 1900, and Lieut. Robert R. Raymond, Corps of Engineers.

The defenses include three works of old type, one of which is used as a depot for torpedo material.

At the beginning of the fiscal year emplacements were completed for sixteen 12-inch mortars, eight 10-inch rifles on disappearing carriages, two 4.7-inch rapid-fire guns on naval mounts, and two 4-inch rapid-fire guns on pedestal mounts; and all of the guns were mounted and ready for service. Emplacements for three 12-inch guns on disappearing carriages, two 12-inch guns on barbette carriages, and two 10-inch guns on disappearing carriages were also essentially complete, ready to receive the armanent. Work was in progress upon emplacements for two 12-inch guns on disappearing carriages, three 6-inch rifles on disappearing carriages, two 5-inch rapid-fire guns on balanced-pillar mounts, five 15-pounder rapid-fire guns, and eight 12-inch mortars, the last named under contract. A tower for a range-finder station was also in process of construction.

During the fiscal year the tower was completed. Three 12-inch guns on disappearing carriages, two 10-inch guns on disappearing carriages, eight 12-inch mortars, three 15-pounder rapid-fire guns on balanced-pillar carriages, two balanced-pillar carriages for 5-inch rapid-fire guns, and two barbette carriages for 12-inch guns were mounted, the guns mounted being all placed in readiness for service. The emplacements for 5-inch rapid-fire guns on balanced-pillar carriages were completed, those for eight 12-inch mortars were nearly completed by hired labor, the contract having expired by limitation, and all other works under construction were well advanced.

The following new works were commenced: Emplacements for two 5-inch rapid-fire guns on pedestal mounts and two 15-pounder rapid-fire guns on balanced-pillar mounts, six position-finder stations, two systems of underground conduit for electric-light and telephone wires, and two central electric-light plants. Of these works, the conduit systems, the electric-light plants, and one position-finder station were completed, and good progress was made on the others.

The submarine-mining material on hand was cleaned, counted, and carefully stored.

Negotiations for the acquisition of additional sites required for the projected defenses were continued throughout the year, titles to several parcels were acquired, and a considerable number of titles were received and are being examined.

Minor works of preservation and repair were made to the different posts and batteries in the harbor.

(See Appendix 3 C.)

Defenses of southeast coast of Massachusetts and Rhode Island, at New Bedford, Mass., and Newport, R. I.—Officer in charge, Maj. Daniel W. Lockwood, Corps of Engineers; assistant, Lieut. Robert P. Johnston, Corps of Engineers; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

The defenses include two permanent masonry works of old type, one of which is garrisoned. During the year minor repairs were made to the garrisoned work.

At the beginning of the fiscal year, under the regular fortification acts, one battery of three 10-inch guns on disappearing carriages, and a battery of sixteen 12-inch mortars had been completed and formally transferred to troops for use and care; and under the "National Defense" appropriation one battery of two 4.7-inch rapid-fire guns, one battery of two 10-inch guns on disappearing carriages, and one battery of one 6-inch rapid-fire gun had been completed and transferred to troops for use and care. Emplacements for two 15-pounder rapid-fire guns had been constructed, but the guns had not been received.

In addition to the above, a concrete cable tank for the storage of torpedo cable and a brick storehouse for storage of mining material had been constructed; plans and estimates had been approved for the construction of two mining casemates, a cable tank, emplacements for two 3-inch rapid-fire guns, and a battery for eight 12-inch mortars, and the latter work had been commenced and about 40 per cent completed.

During the fiscal year the most important operations were as follows: One battery of two 8-inch guns on disappearing carriages and one battery of two 12-inch guns on barbette carriages, that had been practically completed during the preceding year with "National Defense" funds, were completed early in the year with funds allotted from the regular fortification acts, and the first named battery was transferred to an ordnance sergeant on July 31, 1900.

The two mining casemates and the cable tank mentioned above had been constructed, work had been continued on the eight 12-inch mortar battery, and the same was practically completed, all ready to mount the mortars upon their receipt from the Ordnance Department; and work had been commenced in May upon the battery for two 3-inch 15-pounder rapid-fire guns, and this work was in active progress at the close of the fiscal year.

In addition to the above, and during the fiscal year, plans and estimates had been approved for the construction of emplacements for four 5-inch rapid-fire guns (sites for only two of which had been selected), two armored battery commanders' stations and one "Type B" range finder. The battery commanders' stations were constructed and transferred to troops for use and care. Work had been commenced and was in active progress at the close of the fiscal year on the emplacements for two of the four 5-inch rapid-fire guns, but the location for the "Type B" range finder had not been definitely decided upon.

Condemnation proceedings for a site for seacoast defenses along the southern shore of Conanicut Island, Rhode Island, were under way, and title to about 32 acres of land is now vested in the United States. The same kind of proceedings had been in progress during the year for the acquisition of a similar site on the western shore of this island, and at the close of the fiscal year all arrangements had been completed for the payment of the awards in the case.

An electric plant for furnishing light and power was installed in one of the batteries; storage batteries in two other batteries were cared for, and one of them transferred to troops for use and care.

All submarine-mining material on hand was watched and cared for during the year.

(See Appendix 3 D.)

Defenses of eastern entrance to Long Island Sound and coast of Connecticut.—Officer in charge, Maj. Smith S. Leach, Corps of Engineers; assistants, Lieut. William J. Barden, to October 20, 1899, and Lieut. Edward H. Schulz, since October 19, 1899; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

The defenses of New London consist of two works of the old type, containing no modern armament, one of which is an open barbette work, on the east side of the river, in the charge of an ordnance sergeant; the other work is a masonry construction, on the west side of the river. The latter has been garrisoned during the year.

The defenses of the eastern entrance of Long Island Sound are the following:

Two 12-inch B. L. rifles on United States disappearing carriages, model 1897: This battery was built by contract entered into December 11, 1896, and included the construction of a wharf. At the beginning of the fiscal year the battery was complete and armament on hand, but not mounted. It is now completely equipped, armament mounted, and is in the charge of the artillery.

Two 10-inch B. L. rifles on disappearing carriages, model 1896: This battery was built under "National Defense" appropriation, and was begun in March, 1898. At the beginning of the fiscal year it was complete, with armament mounted. The battery is in the charge of the artillery.

Two 10-inch B. L. rifles on disappearing carriages, model 1896, and a mining casemate: This work was done under contract entered into August 11, 1897, and included a crib wharf. At the beginning of the fiscal year it was complete and armament mounted. During the year there was built a battery commander's station and instrument mounted. The battery is in the charge of the artillery. The casemate has been completed, and is cared for by the Engineer Department.

Eight 12-inch B. L. steel mortars: Work on this battery was begun about July 1, 1898. At the beginning of the fiscal year, excavation and placing of concrete were well under way. The battery is now practically complete, except consolidation of rear slopes, concreting terreplein, and the installation of electric power. A battery commander's station pertaining to this battery has been completed during the fiscal year. The armament is on hand; one carriage and one mortar have been mounted by the troops. The contract for electric-light plant has been made. This battery has not been formally transferred to the artillery.

Two 6-inch rapid-fire guns on disappearing mounts: Work was begun in the early part of 1899. At the beginning of the fiscal year materials had been collected and excavation partly made. The battery is now complete, except consolidation of slopes and electric lighting. The carriages are on hand, not mounted. Guns not yet received. Not yet transferred to the artillery.

One 4.7-inch rapid-fire Armstrong gun: This emplacement was built under "National Defense" appropriation and was complete, with armament, at beginning of fiscal year. During the year it has been transferred to the artillery.

One 5-inch rapid-fire wire-wound gun: This emplacement was begun and built during the fiscal year. It is about nine-tenths complete. The armament has not yet been received.

Two 8-inch B. L. rifles on United States disappearing carriages, model 1896, and two 5-inch rapid-fire guns on balanced-pillar mounts: Work was begun the latter part of 1898. At the beginning of the fiscal year the 8-inch emplacements were up to ceiling level, and the 5-inch emplacements were practically completed, except armament. The 8-inch emplacements are now completed, two carriages and one gun being mounted. The remaining gun not yet received. Electric lighting complete. The 5-inch rapid-fire emplacements are finished and carriages mounted. Guns not received. No garrison is present.

Two 5-inch rapid-fire wire-wound guns: An allotment for this battery was made during the fiscal year. The work is practically complete, except electric wiring and sodding slopes. Armament not yet received. No garrison is present.

Two 8-inch B. L. rifles on 15-inch smoothbore carriages, converted: At the beginnning of the fiscal year the battery was ready for armament. Guns are on hand. The converted carriages are on hand, but not mounted. Electric light installed. No garrison is present.

Two 5-inch rapid-fire wire-wound guns: These emplacements, with connecting parados, are built in rear of two 8-inch emplacements. A sea wall was built for protection of the site. Further repairs to sea wall will be made. At beginning of fiscal year the battery was complete, except platform and superior slope. Both of these emplacements are now completed. Armament not received. No garrison is present.

Two 12-inch B. L. rifles on United States disappearing carriages, model 1897; two 10-inch B. L. rifles on United States disappearing carriages, model 1896; and three 6-inch rapid-fire guns on disappearing mounts: Work was begun in December, 1898. At the beginning of fiscal year, excavation and placing of concrete were well advanced. The 10-inch emplacements are now completed, except the ammunition hoists and electric lighting. Concrete for the 12-inch emplacements is nearing completion. The armament is all on hand. The 10-inch guns are mounted and are protected by penthouses built over them. Excavation for the 6-inch emplacements was begun in December, 1898. At the beginning of fiscal year 4,000 yards of excavation had been done. One of the emplacements is finished to loading platform, and the other two are well under way. The carriages are on hand but not mounted. Guns not yet received. No garrison is present.

(See Appendix 3 E.)

Defenses of New York City.—Officer in charge of artillery defense and of torpedo defense of southern entrance to harbor, Maj. Henry M. Adams, Corps of Engineers, to November 16, 1899; the late Lieut. Col. William H. H. Benyaurd, Corps of Engineers, from November 16, 1899, to January 8, 1900, and Maj. William L. Marshall, Corps of Engineers, since January 8, 1900; assistants, Lieut. James F. McIndoe, Corps of Engineers, Lieut. Jay J. Morrow, Corps of Engineers, to to August 27, 1899, and Lieut. James A. Woodruff, Corps of Engineers. Officer in charge of torpedo defense of eastern entrance to harbor, Maj. John G. D. Knight, Corps of Engineers. Division Engineer, Col. George L. Gillespie, Corps of Engineers.

Eastern entrance to harbor.—At the beginning of the fiscal year emplacements had been completed and turned over to the garrisons for the following guns and mortars, which were mounted, viz: Two 8-inch and four 10-inch guns on disappearing carriages and twenty-four 12-inch breech-loading mortars. One emplacement for 12-inch gun on disappearing carriage had been completed and armed; this has since been turned over to the garrison.

Three 12-inch emplacements, then under way, have since been completed and armed; four emplacements for 5-inch rapid-fire guns, then in progress, have since been completed and are ready for aramament; four emplacements for 15-pounder rapid-fire guns have been completed, and two of them are armed; two additional emplacements for 5-inch rapid-fire guns have been begun and are in process of construction; one mining casemate, completed during the preceding fiscal year, was turned over to the garrison during the past year. Two range-finder stations have been authorized, built, and completed; one has been turned over to the garrison and the other is now ready for transfer. Electric-lighting plants have been built and are nearly completed for all the batteries. An allotment for sea-wall construction has been made.

Southern entrance to harbor on Staten Island, Long Island, and at Sandy Hook, New Jersey.—At the beginning of the past fiscal year emplacements had been completed and turned over to the garrisons for the following guns and mortars, which had been mounted, viz: Sixteen 12-inch breech-loading mortars, two 12-inch guns on lifts, thirteen 10-inch and five 8-inch guns on disappearing carriages, and two 4.7-inch rapid-fire guns, together with one 5-inch siege rifle, one 7-inch siege howitzer, and one 4.7-inch rapid-fire gun in temporary emplacements. One pneumatic-gun battery for three dynamite guns with temporary magazines, two mining casemates, seven cable tanks, and two storage buildings for submarine mining materials were also completed.

The following emplacements were at the beginning of the fiscal year either completed or nearly completed, viz: Six 12-inch and three

10-inch guns on disappearing carriages, two 12-inch guns en barbette, two 6-inch rapid-fire guns on pedestal mounts, and two 4.7-inch rapid-fire guns. They have since been completed, armed, and turned over to the garrisons.

During the past fiscal year the following additional work has been done:

Six emplacements for 12-inch guns on disappearing carriages, two nearly completed and two under way, have been completed and are ready for armament; two have been begun and are about half completed. Four emplacements for 6-inch guns on disappearing carriages, two under way, have been completed and are ready for armament, and two have been begun and are nearly half completed. Eight emplacements for 12-inch breech-loading mortars have been begun and base rings are now set. Four emplacements for 15-pounder rapid-fire guns, two awaiting armament and two begun and ready for base cylinders. Three range-finder stations and one steel range-finder tower have been completed and turned over to the garrisons.

Electric-lighting plants have been installed or are in process of construction at all the fortifications.

Allotments have recently been made for construction of two additional emplacements for 15-pounder rapid-fire guns and of permanent retaining walls with bombproofs for pneumatic dynamite-gun battery.

Plans and estimates are in preparation for two emplacements for 12-inch guns on disappearing carriages and for five range-finder stations.

Condemnation proceedings are in progress for the acquisition of two additional tracts of land for the enlargement of an existing reservation.

The torpedo property has been inspected and cared for.

(See Appendix 3 F.)

Defenses of the Delaware River.—Officer in charge, Lieut. Col. Charles W. Raymond, Corps of Engineers, to April 6, 1900, and since May 31, 1900; assistants, Lieut. Spencer Cosby, Corps of Engineers, to January 1, 1900, from February 21 to April 6, 1900, and since May 31, 1900, and Lieut. J. B. Cavanaugh, Corps of Engineers, since June 11, 1900. The district was in the charge temporarily of Lieut. Spencer Cosby from April 6 to May 31, 1900.

The defenses include two masonry works of old type, one of which is in the charge of an ordnance sergeant. No new work is contemplated at this site. Modern batteries are in course of construction at the other site. Modern works of defense are also located at two other points on the river, which are garrisoned.

The modern batteries built or building for the defense of the Delaware consist of a battery of three 12-inch and three 10-inch guns on disappearing carriages, a battery of two 5-inch rapid-fire guns, a battery of three 12-inch guns on disappearing carriages, two batteries of two 15-pounder rapid-fire guns each, a battery of two 4.72-inch rapid-fire guns, a battery of sixteen 12-inch mortars, a battery of two 12-inch guns on nondisappearing carriages, and two 8-inch guns on disappearing carriages, and two batteries each of two 5-inch rapid-fire guns, segmental wire wound.

The battery of six 10-inch and 12-inch guns on disappearing carriages had been completed with all guns and carriages mounted, and on January 6, 1899, it was turned over to the artillery garrison. Work of a minor character was carried on during the year and the construction of the parados in rear was completed. The battery proper had cost to June 30, 1900, $244,727.70 and the parados $18,554.32.

The two emplacements for 5-inch rapid-fire guns on balanced-pillar mounts have been completed and ready since August, 1897, for the guns and carriages, which have not yet been received. The battery has cost $19,341.80.

At the end of the fiscal year the battery of three 12-inch guns on disappearing carriages was practically completed, with the guns and carriages mounted. Six thousand seven hundred and forty-one cubic yards of concrete masonry was placed during the fiscal year. The ammunition hoists, boiler for the electric plant, and a few doors are yet to be installed. Its cost to June 30, 1900, was $334,229.27.

The two emplacements for 15-pounder rapid-fire guns on each flank were completed ready for the carriages.

The battery for two 4.72-inch rapid-fire guns was completed, and the guns mounted on December 31, 1898.

At the beginning of the fiscal year the battery of sixteen 12-inch mortars was completed, with the exception of some grading of the slopes and grounds. All sixteen carriages and eight of the mortars were mounted ready for service. The other eight mortars have not yet been received. The work on the battery was completed during the year, and the battery was turned over to the artillery garrison on May 2, 1900. The cost of the battery to June 30, 1900, is $217,837.70.

The two emplacements for 8-inch disappearing guns, with the carriages and guns mounted, and the two emplacements for 12-inch guns and nondisappearing carriages were turned over to the artillery garrison on January 12, 1899. At the end of the last fiscal year the mounting of the two 12-inch guns was in progress. The work was completed on August 4, 1899. These four emplacements were constructed under an allotment from the appropriation for "National Defense."

One battery of two 5-inch rapid-fire guns, segmental wire wound, was nearly completed at the end of the fiscal year, and work on the second had just begun.

The regular semiannual inspections of torpedo material were made and the material kept in shape to prevent deterioration.

Four type "B" range finders have been mounted for the completed batteries, and instructions have been given for the preparation of plans for the erection of two battery commanders' stations.

During the year, under various allotments from appropriations for "Preservation and Repair of Fortifications," suspended ceilings were put in magazines of batteries to correct dampness in magazines, a bracketed gallery connecting gun platforms of the six-gun battery was constructed, electric-lighting plants were cared for, and other works of maintenance and repair carried on.

(See Appendix 3 G.)

Defenses of Baltimore, Md.—Officer in charge, Lieut. Col. Oswald H. Ernst, Corps of Engineers, from April 14, 1900, having under his immediate orders Lieut. Charles W. Kutz, Corps of Engineers, the latter being in temporary charge until April 14, 1900.

There are five forts in the system—four of the modern and one of the old type.

At the beginning of the fiscal year there were already constructed at one site a battery containing one 12-inch and three 8-inch B. L. rifles on disappearing carriages, together with two 4.7-inch rapid-fire guns. A flanking battery for two 15-pounder rapid-fire guns, which had been practically constructed, was completed during the fiscal year.

At another locality a battery for two 12-inch B. L. rifles on barbette carriages, two emplacements for 5-inch rapid-fire guns on balanced-pillar mounts, and two emplacements for 15-pounder rapid-fire guns were practically completed at the beginning of the fiscal year, and these were finished up and the guns mounted in the 12-inch emplacements during the fiscal year.

At a third reservation there were already constructed at the beginning of the fiscal year one battery containing eight 12-inch B. L. mortars, two emplacements containing 12-inch B. L. rifles on disappearing carriages, two emplacements for 5-inch rapid-fire guns on balanced-pillar mounts, and two emplacements for 15-pounder rapid-fire guns, with the exception of the earth parapet and minor details. The operations of the fiscal year have consisted in adding two emplacements for 6-inch rapid-fire guns on disappearing carriages, finishing two emplacements for 15-pounder rapid-fire guns, and taking preliminary steps toward adding two similar emplacements; mounting the carriages in the 6-inch emplacements and mounting the carriages in the 5-inch emplacements.

At a fourth site two emplacements for 6-inch rapid-fire guns on disappearing carriages were virtually constructed during the fiscal year, and the carriages mounted.

The operations of the fiscal year also consisted in the construction of a torpedo storehouse and completing a mining casemate at one site, protecting one reservation with a sea wall and embankment, partially protecting a second reservation with a sea wall and embankment, and making preliminary arrangements to protect a third in the same manner, together with making the necessary repairs to the completed works and furnishing the garrisons with supplies for the electric lighting and power plants. The submarine-mine material was stored and kept in order for immediate use.

(See Appendix 3 H.)

Defenses of Washington, D. C.—Officer in charge, Lieut. Col. Charles J. Allen, Corps of Engineers.

At the close of the fiscal year 1900 there were completed emplacements for six 10-inch guns, three 8-inch guns, and two 4-inch rapid-fire guns. In addition there were under construction emplacements for eight 12-inch mortars, for two 6-inch guns on disappearing carriages, for two 5-inch rapid-fire guns on balanced-pillar mounts, and for five 15-pounder rapid-fire guns on balanced-pillar mounts. It is expected that all of these will be completed during the next fiscal year, provided the necessary armament is received.

Four battery commanders' stations, pertaining to the approved system of fire control, are under construction; also an electric light and power plant for the battery of 8-inch guns.

A number of necessary repairs was made to the batteries, buildings, and wharf.

The torpedo material was regularly inspected and kept in repair.

(See Appendix 3 I.)

Defenses of Hampton Roads, Virginia.—Officers in charge, Maj. Thomas L. Casey, Corps of Engineers, until December 21, 1899, and Maj. James B. Quinn, Corps of Engineers, since that date; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

The old-style works in existence at this point consist of one earth and masonry garrisoned fort on the north side of the channel and one ungarrisoned fort built entirely of masonry directly opposite, on the south side of the channel. Slight repairs have been made to the former during the fiscal year 1900. The latter has no armament, but under the approved project of defense modern guns are to be provided.

Besides the obsolete old-style armament in the fort on the north side of the channel, provision had been made at the close of the fiscal year 1899 for eight 10-inch and five 8-inch guns, sixteen 12-inch mortars, and four 4.72-inch rapid-fire guns. With the exception of two 10-inch and two 8-inch, all the above guns and their carriages had been mounted. Four of the 8-inch guns were provided during the war with Spain, and the two reported as not mounted were removed from their platforms during the previous fiscal year and shipped to other places. In connection with the service of the guns the fire commander's and three observation stations have been completed.

In defending this locality by submarine mines two mining casemates and cable galleries have been built and a cable tank provided for the wet storage of cable.

Work in the fiscal year 1900 was confined to continuing the construction of the single 10-inch battery in a bastion of the main work (now practically completed) and the three 12-inch battery, which is completed with the exception of building a portion of the slope at the south end and the finishing up of the electric storage battery installation for lighting purposes. Work, minor in nature, was also done at Redoubts B and C, and a battery for four 15-pounder rapid-fire guns commenced. The latter is practically finished.

The only increase in the armament during the fiscal year was one 10-inch gun, which was on hand June 30, 1899, but had not been mounted by the garrison at that date.

With funds from the recent fortification appropriation it is proposed to undertake the construction of emplacements for two 12-inch guns at the fort on the south side of the channel, to extend the sea wall from the east side of the Engineer Wharf to the farther side of the first jetty on the beach, and to construct one of the proposed battery commanders' stations at the fort on the north side.

(See Appendix 3 J.)

Defenses of the coast of North Carolina.—Officer in charge, Capt. E. W. Van C. Lucas, Corps of Engineers; assistant, Lieut. Earl I. Brown, Corps of Engineers, until September 6, 1899; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

The defenses include the old-style Fort Macon, the reservation at Southport, and the modern batteries at the mouth of Cape Fear River.

At the beginning of the fiscal year the conditions were as follows: One battery of four 8-inch B. L. rifles, one battery of two 12-inch B. L. rifles, one 4.7-inch rapid-fire gun, one central lighting and power plant were completed, guns installed, and the whole turned over to the garrison; also two emplacements for 5-inch rapid-fire guns completed and awaiting armament, emplacements for eight 12-inch mortars in course of construction, and submarine mining equipment, including torpedo casemate and partially completed storehouse, in the charge of Engineer Department.

During the year the submarine mining storehouse was completed and material stored therein; the mortar emplacements were completed and the guns were mounted, and the battery needs only the installation of electric firing apparatus before turning over to the garrison. With allotments from appropriation for "Preservation and Repair of Fortifications" considerable repair and improvement were done, including releveling 8-inch guns and improving drainage. An ammunition hoist for 4.7 inch rapid-fire gun was purchased and installed.

(See Appendix 3 K.)

Defenses of the coast of South Carolina.—Officer in charge, Maj. Ernest H. Ruffner, Corps of Engineers, until May 7, 1900, and Capt. James C. Sanford, Corps of Engineers, since that date; assistant, Lieut. E. H. Schulz, Corps of Engineers, until October 16, 1899; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Charleston Harbor.—The defenses consist of the following:

Mortar battery, sixteen 12-inch B. L. mortars. This battery was practically completed in June, 1897, and the mortars were all mounted by the spring of 1898. During the past year the floors of the magazines were raised, drain was renewed, fence built around reservation, and minor repairs made.

Four 10-inch rifles on disappearing carriages. This battery was completed in 1898. During the past year minor repairs have been made.

Six-inch rapid-fire battery. This is a battery of two 6-inch guns. The left emplacement is for a pedestal mount, and was completed the previous fiscal year. The right-hand emplacement is for a disappearing carriage, and was completed during the fiscal year. The carriage was mounted by the artillery. The battery has been turned over to the artillery. In 1898 two emplacements for 4.7-inch rapid-fire guns had been completed, the guns mounted, and the battery turned over to the artillery. Three emplacements for 15-pounder rapid-fire guns on balanced-pillar mounts were built during the previous fiscal year. The guns and carriages for these three emplacements have not yet been received.

Two emplacements for 12-inch rifles were built during the previous fiscal year, and the barbette carriage and gun had been mounted. During the fiscal year the disappearing carriage and gun were mounted, and the battery turned over to the artillery. An electric-lighting plant was installed.

Torpedo defense. The torpedo material was stored and cared for.

Port Royal Sound, South Carolina.—The defenses consist of the following: Three 10-inch rifles on disappearing carriages. The three emplacements were finished and two carriages mounted during the previous fiscal year. The remaining carriage and the three rifles were mounted during the fiscal year; an electric-lighting plant was installed, and the battery was turned over to the artillery. Minor repairs were made to battery, and plant was cared for.

Two 4.7-inch rapid-fire emplacements had been built in 1898, and the guns mounted. This battery was turned over to the artillery. No repairs were necessary, and nothing was done during the fiscal year.

A temporary battery for two 8-inch rifles on 15-inch smoothbore carriages had been built during previous fiscal year. No repairs were made during the year. This battery was turned over to the artillery.

Torpedo defense. The torpedo material has been stored and cared for. No casemate has yet been built.

(See Appendix 3 L.)

Defenses of the coast of Georgia and of Cumberland Sound, Georgia and Florida.—Officer in charge defenses of coast of Georgia, Capt. Cassius E. Gillette, Corps of Engineers; assistant, Lieut. Lytle Brown, Corps of Engineers, until August 10, 1899. Officers in charge of defenses of Cumberland Sound, Capt. Charles H. McKinstry, Corps of Engineers, until May 24, 1900, and Capt. Cassius E. Gillette, Corps of Engineers, after that date; assistant, Lieut. Edward M. Markham, Corps of Engineers, until May 24, 1900. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

The defenses include three masonry works of old type.

During the fiscal year the battery of eight 12-inch mortars was completed and was transferred to the artillery. The permanent emplacements for two 4.7-inch rapid-fire guns were completed, but have not been transferred. Two batteries of two 15-pounder rapid-fire guns each, the mounts for which have not yet been supplied, were also completed.

Under the appropriation for "Preservation and Repair of Fortifications" minor operations were carried on at the forts on the coast of Georgia.

(See Appendix 3 M.)

Defenses of the east coast of Florida and of Key West, Fla.—Officer in charge, Capt. Charles H. McKinstry, Corps of Engineers, until May 24, 1900, after which date Capt. Thomas H. Rees, Corps of Engineers, was in temporary charge; assistant, Lieut. Edward M. Markham, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

The defenses include two masonry works of old type. One of them, Fort Marion, is of little value for defensive purposes. Built by the Spaniards in the eighteenth century, it is an interesting relic and has been cared for as such. It was in use as a military prison during the first portion of the year. The other work has been dismantled of its old armament and a portion of it has been torn down.

Near the mouth of the St. Johns River the temporary batteries built during the war with Spain were practically abandoned and their armament was shipped away. Engineer property and torpedo material stored here were cared for during the year with funds provided from the appropriation for "Preservation and Repair of Fortifications."

A boundary survey and a topographic survey were made of land required for site for permanent works of defense.

At Key West emplacements for four 10-inch and two 8-inch guns on disappearing carriages and for eight 12-inch mortars are still under construction by contract entered into March 4, 1897, under the provisions of the act approved June 6, 1896. These emplacements were to be completed by January 1, 1898. The time for completion has been extended by the Secretary of War; the extension last made will expire July 23, 1900. Very little work was done by the contractor during the year. The condition of the batteries is practically the same as reported last year, except that the amount of sand fill remaining to be placed in the gun battery has been reduced to 3,987 cubic yards.

Emplacements for two 12-inch guns mounted on barbette nondisappearing carriages were completed and turned over to the troops for use and care.

Emplacements for two 4.7-inch rapid-fire guns were turned over to the troops for use and care.

Four emplacements for 15-pounder rapid-fire guns are under construction, but work has been suspended on account of the nonarrival of the gun mounts, which prevents the construction of the concrete bases above the level of the bottom of the well casing.

Plans have been prepared for two additional emplacements for 15-pounder rapid-fire guns, and funds for their construction have been allotted.

The installation of electric-light plants in the gun battery and the mortar battery was completed and the plants were turned over to the troops for use and care.

A number of minor repairs necessary for the preservation of the fortifications and the buildings were made and the torpedo material was cared for.

(See Appendix 3 N.)

Defenses of Tampa Bay, Florida.—Officers in charge, Capt. Henry Jervey, Corps of Engineers, until January 18, 1900, and Capt. Thomas H. Rees, Corps of Engineers, since that date; assistant, Lieut. Frank C. Boggs, Corps of Engineers, until June 15, 1900.

During the year a cable tank has been completed by the installation of a traveling crane, which was under construction at the beginning of the fiscal year.

The construction of two emplacements for 8-inch breech-loading rifles on disappearing carriages and of a battery for eight 12-inch mortars has been completed. Both these works were turned over to the artillery command on May 8, 1900.

Other work done consisted of the two regular semiannual inspections of the mining material, the moving, cleaning, and general overhauling of same, and the repairs to a dock at Egmont Key, for all of which the necessary funds were provided from the appropriation for "Preservation and Repair of Fortifications."

(See Appendix 3 O.)

Defenses of Pensacola, Fla.—Officer in charge, Capt. Clement A. F. Flagler, Corps of Engineers; assistant, Lieut. Lewis H. Rand, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

A battery mounting four 10-inch guns on disappearing carriages was completed in 1897–98. The electric plant to this battery is now being remodeled and extended, to prevent dampness and crowding of machinery.

A battery mounting two 12-inch guns on disappearing carriages was completed in 1898–99, except the armament. The armament was installed in 1899.

A battery mounting eight 12-inch mortars was completed in 1898–99, except the mortars, which were mounted in 1899. Some work was also done on the slopes of this battery during the year.

A battery mounting two 8-inch guns on disappearing carriages was completed in 1898–99, except the guns, which were mounted in 1899.

A battery mounting two 4.7-inch rapid-fire guns was completed and the armament mounted in 1898–99.

A battery for four 15-pounder rapid-fire guns on balanced-pillar mounts was completed in 1900. Armament not yet received.

The defenses include two masonry works of old type. One bastion of one of these forts was demolished by the explosion of a magazine June 20, 1899. Both of these works received minor repairs during the year.

The slopes of all works except the 8-inch battery were repaired where cut by rain and waves. Property scattered and injured by the explosion mentioned was collected, cleaned, repaired, and stored. Several expedients were tried to prevent dampness in magazines, wharf and railroad tracks were repaired, and minor repairs made in all batteries.

The torpedo storehouse and the cable-tank house, destroyed by the explosion mentioned, were reconstructed, mining casemate repaired, and torpedo material collected, cleaned, and stored.

(See Appendix 3 P.)

Defenses of Mobile and Mississippi Sound.—Officer in charge, Maj. William T. Rossell, Corps of Engineers; assistant, Lieut. James B. Cavanaugh, Corps of Engineers, until June 10, 1900; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

These defenses consist of three works of the older type, two of which are in the charge of ordnance sergeants, and the following modern works:

SITE NO. 1.

A battery of two 12-inch B. L. rifles mounted on disappearing carriages.

A battery of eight 12-inch B. L. steel mortars.

A battery of four 8-inch B. L. rifles mounted on disappearing carriages.

A battery of two 4.7-inch Armstrong rapid-fire guns on pedestal mountings.

A battery of two 15-pounder rapid-fire guns on balanced-pillar mountings.

SITE NO. 2.

A battery of two 8-inch B. L. rifles mounted on modified 15-inch Rodman carriages.

A battery of two 6-inch rapid-fire guns mounted on United States disappearing carriages.

At the beginning of the fiscal year the four 8-inch and 4.7-inch batteries were both completed and turned over to the artillery. The two 8-inch batteries at Site No. 2 were complete, ready to be turned over to the artillery. These batteries were transferred to the care of the garrison.

The 12-inch B. L. rifle battery was complete with the exception of the sand parapet. During the fiscal year the remaining work on this battery, including grading and sodding of sand parapet, receiving and hanging doors, and painting ironwork of battery, was completed, and the battery was turned over to the artillery on June 4, 1900.

Work on the mortar battery was well under way at beginning of present fiscal year. Plant had been installed. the greater part of framing erected, excavations made for foundations of battery, part of materials for construction received, and about 25 per cent of concrete put in place. During the fiscal year the concrete work on this battery was completed, speaking tubes placed connecting various stations, trolleys and trolley beams erected, doors constructed and hung, and all wood and iron work painted, electric plant installed. The greater portion of the eight mortar carriages were moved to the battery, the base rings leveled and set, and carriages assembled to the height of the loading platform.

At the beginning of the fiscal year work upon the 15-pounder battery had been commenced, foundations for magazines were prepared, framing erected, and placing concrete commenced. During the fiscal year work on this battery was completed, including placing concrete, wiring up the magazines and connecting same with power plant of 12-inch battery, painting all wood and iron work, filling sand in parapet, and grading and sodding slopes of same.

At the beginning of the fiscal year plans had been prepared for the 6-inch rapid-fire battery at Site No. 2, and preliminary work of obtaining materials and supplies begun. During the fiscal year work on this battery was carried on, completing the placing of concrete, with the exception of that for four flights of stairs and the walk in rear of battery. Electric plant, ammunition hoists and trolleys, cranes, and stairways have yet to be installed, and filling sand in parapet has yet to be completed.

With funds allotted from appropriation for "Sea Walls and Embankments" at one work, 1,320 linear feet of sea wall was completed and mattress sunk for an additional 155 linear feet. The various defensive works were kept in repair, as occasion required, with funds from the appropriation for "Preservation and Repair of Fortifications." The submarine mine material was regularly inspected and kept in serviceable condition.

(See Appendix 3 Q.)

Defenses of New Orleans, La., and Sabine Pass, Tex.—Officers in charge, Maj. James B. Quinn, Corps of Engineers, until December 1, 1899, and Maj. Henry M. Adams, Corps of Engineers, since that date; assistant, Lieut. Clarke S. Smith, Corps of Engineers, until August 10, 1899; Division Engineer, Col. Henry M. Robert, Corps of Engineers.

New Orleans, La.—The defenses of New Orleans include several masonry works of old type, one of which was garrisoned throughout the year, another being in the charge of an ordnance sergeant.

At the beginning of the fiscal year the following modern emplacements were completed and provided with armament:

One battery of two 10-inch B. L. rifles, disappearing carriages.

Two batteries of two 8-inch B. L. rifles each, disappearing carriages.

One battery of two 4.7-inch rapid-fire guns, pedestal mounts.

Emplacements for four 3-inch 15-pounder rapid-fire guns, with pillar mounts, were practically completed, but guns not mounted.

Two electric-light plants were completed and two searchlights provided. A new shelter for one of the electric-light plants was in course of construction, to replace a concrete building constructed in 1898. The unequal settlement of the 10-inch emplacements had thrown the gun platforms and the floors of the magazines considerably out of level, preventing drainage and causing dampness in the magazines and passageways. The gun platforms of both 8-inch batteries also required releveling from the same cause.

During the past fiscal year the emplacements for four 15-pounder rapid-fire guns were wired for lighting and completed as far as possible in advance of receipt of the guns and carriages.

The new shelter for the electric-light plant was completed and the machinery moved into it. The machinery was cleaned, repaired, and run at intervals.

Two 10-inch and two 8-inch emplacements were provided with iron hand rails. An ammunition hoist was installed in one 8-inch battery not previously provided. The platforms and base rings of the 10-inch guns and the platforms of the 8-inch batteries were leveled. The superior slopes were repaired, drains were cut around the new batteries, and other similar work done to decrease dampness in the magazines and passageways. The results obtained are satisfactory.

The removal of a portion of one old fort and its adjacent obsolete batteries to secure a better view of the river from the 8-inch battery was authorized by the Secretary of War on December 26, 1899. In the progress of this work thirteen obsolete guns and carriages were removed.

With funds allotted from the appropriation "Torpedoes for Harbor Defense" a torpedo storehouse was constructed, and that part of the torpedo material previously stored in damp casemates and magazines of the old fort was moved. Since removal the material has been maintained in good condition.

Minor repairs were made during the year as far as permitted by the limited funds available. The modern guns and carriages not in the charge of the garrison were cared for. Parts of the electrical machinery, guns, and carriages liable to rust were painted. All serviceable engineer property was cleaned and, where necessary, painted. Shelters were constructed over the principal parts of the working plant. Civilian watchmen are at present in charge of the torpedo property.

On October 25, 1899, the two 8-inch batteries, the 4.7-inch battery, and two electric-light plants, including the searchlights, were transferred to the garrison. The 10-inch battery was transferred on June 7, 1898.

Sabine Pass, Tex.—The defenses of this place were constructed during the war with Spain on ground not owned by the United States, and consisted of a temporary battery for four light bronze 12-pounder field guns and one 8-inch B. L. rifle mounted on an old converted carriage. An ordnance sergeant was in charge until October 31, 1899, when he was relieved and the armament withdrawn.

All torpedo property on hand is stored and in good condition. No work was done during the past year.

(See Appendix 3 R.)

Defenses of Galveston, Tex.—Officer in charge, Capt. Charles S. Riché, Corps of Engineers; Division Engineer, Col. Henry M. Robert, Corps of Engineers.

At the beginning of the present fiscal year the modern batteries consisted of—

Emplacements for two 10-inch guns, battery No. 1, completed and armed.

Emplacements for eight 12-inch mortars, battery No. 1, completed and armed.

Emplacements for two 4.7-inch rapid-fire guns, completed and armed.

Emplacements for two 10-inch guns, battery No. 2, completed but not armed, armament being assembled.

Emplacements for two 8-inch guns, completed but not armed, armament being assembled.

Emplacements for eight 12-inch mortars, battery No. 2, and for seven 15-pounder rapid-fire guns were in progress of construction.

Cable tank and torpedo storehouse built and torpedo material stored in same.

Electric light and power plant for 10-inch battery No. 1 and 12-inch mortar battery No. 1 in progress of construction.

During the fiscal year the armament for the 10-inch gun battery No. 2 and the 8-inch battery were assembled, emplacements for two 15-pounder guns, battery No. 1, and emplacements for three 15-pounder guns were completed, and emplacements for two 15-pounder guns, battery No. 2, were completed, except blast surfaces and riprap protection to sheet-piling revetment. None of the 15-pounder rapid-fire guns had been received up to the close of the fiscal year. Eight 12-inch mortars and carriages for mortar battery No. 2 had been received.

Electric light and power plant at 10-inch gun battery No. 1 and 12-inch mortar battery No. 1 were completed.

Work of construction of 12-inch mortar battery No. 2 was continued during the year, and good progress was made. Some delay was caused in construction on account of having to stop work until sand protection was completed.

Site for emplacements for 6-inch guns was filled in by the U. S. dredge *Gen. C. B. Comstock.*

A system of tracks for submarine mining service was constructed.

During the fiscal year the following fortification works were transferred to the artillery for their care and use under the provisions of Army Regulations 1486: 12-inch mortar battery No. 1, 10-inch gun battery No. 1, 10-inch gun battery No. 2, 8-inch gun battery, 15-pounder rapid-fire battery No. 1, 15-pounder rapid-fire battery (three emplacements), 4.7-inch rapid-fire battery, electric light and power plants at 10-inch gun battery No. 1 and 12-inch mortar battery No. 1, power house at 10-inch gun battery No. 1.

It was hoped that the 12-inch mortar battery No. 2 and the 15-pounder rapid-fire battery No. 2 would be completed and the mortars and guns mounted during the fiscal year ending June 30, 1901, but the disastrous gale of September 8–9, 1900, was so terribly destructive that it is not probable that further extensive operations upon the fortifications will be attempted during the present calendar year.

The condition of the works of defense of Galveston after the subsidence of the hurricane of September 8–9, 1900, will be made the subject of a separate report at a later date.

(See Appendix 3 S.)

Defenses on the Great Lakes.—Officer in charge of defenses of Detroit River, Lieut. Col. Garrett J. Lydecker, Corps of Engineers. Officer in charge of defenses of Lake Champlain, Col. John W. Barlow, Corps of Engineers. Officers in charge of defenses of other lake ports in New York, Capt. Graham D. Fitch, Corps of Engineers, until February 13, 1900, and since April 26, 1900, and Maj. Thomas W. Symons, Corps of Engineers, from February 13 to April 26, 1900; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

These consist of four works of older type, three of which are garrisoned, and one in the charge of a fort-keeper and an ordnance sergeant. Operations during the year consisted of the repair of the fence surrounding the reservation at one fort, the repair of works of shore protection at another, and minor works of repair and preservation.

(See Appendix 3 T.)

Defenses of San Diego, Cal.—Officer in charge, Capt. James J. Meyler, Corps of Engineers; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers.

At the close of the previous fiscal year the four emplacements of the battery of four 10-inch guns on disappearing carriages were completed, with the exception of a few minor details and a small amount of earthwork. Three of the guns had been mounted; a mining casemate and a concrete cable tank had also been built; the construction of an engine-room addition to the mining casemate was nearing completion; a torpedo storehouse was almost completed, and work on emplacements for two 15-pounder rapid-fire guns, which were authorized on April 8, 1899, under the act of July 7, 1898, was about half completed at the end of the fiscal year. Besides these works, sites had been selected for emplacements for two 5-inch rapid-fire guns, and plans and estimates for their construction had been submitted for approval on June 21, 1899.

All of the work done during the fiscal year ending June 30, 1900, was by hired labor. At the fourth 10-inch emplacement a wing wall was built, earthwork and grading were completed, and the base ring set. The gun and the carriage have since been mounted by the artillery garrison. In the other three emplacements of the 10-inch battery, the elevator brackets, having proved too weak, were replaced by stronger ones, and holes were cut in the walls between powder and shell rooms for the purpose of increasing the air circulation in the powder rooms.

The remaining work on the engine-room addition to the mining casemate was completed early in the year. A picket fence was put up around the stairway and light well, and a part of the machinery and a battery case were installed in the room. At the torpedo storehouse a small wharf was built out to near low water, and narrow-gauge tramways were laid, connecting the wharf with the storehouse and the cable tank.

The concrete work of the 15-pounder battery was finished, excepting the gun platforms and a small apron. The grounds in front and rear have since been graded, and all other detail work in the battery completed. Ground was broken on the site of the 5-inch battery for two rapid-fire guns on August 21, 1899, and the excavation was completed in the latter part of September. The concrete work which was then begun was finished in December. All other detail work has since been finished, and the battery, like the 15-pounder battery, is completed with the exception of the gun platforms, which are awaiting certain castings.

Under date of March 3, 1900, an allotment was made for the construction of a battery commander's station. Ground was broken on the site of this building during the month of March, and since then the concrete walls have been completed. At the close of the year the iron and the steel work were being put in place, and it was contemplated that another month's work would complete the structure.

During the latter part of the fiscal year plans and estimates were being prepared for the construction of another battery of two emplacements for 15-pounder rapid-fire guns.

Regular inspections were made of the torpedo material, and the same kept in order.

(See Appendix 3 U.)

Defenses of San Francisco, Cal.—Officer in charge of artillery defenses, Maj. Charles E. L. B. Davis, Corps of Engineers; assistants, Lieut. (now Capt.) Herbert Deakyne, Corps of Engineers, until April 23, 1900, and Lieut. William Kelly, Corps of Engineers, until June 29, 1900; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers. Officer in charge of torpedo defenses, Lieut. Col. William H. Heuer, Corps of Engineers; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers, until January 29, 1900.

The old defense included two masonry works and a number of earthen barbette batteries of old type at various points in the harbor, while eleven platforms have been built for 8-inch converted rifles.

At the close of the last fiscal year the modern defenses consisted of thirty-two 12-inch mortars mounted in two batteries; nine emplacements for 12-inch guns completed, and all the guns mounted; four emplacements for 12-inch guns almost completed; five emplacements for 10-inch guns completed and all the guns mounted; six emplacements for 8-inch guns completed, but guns not mounted; four emplacements for 5-inch rapid-fire guns on pillar mounts completed as far as practicable until the receipt of the mounts; two emplacements for 8-inch guns and two emplacements for 6-inch guns commenced; and the protection work of the three 15-inch pneumatic dynamite guns nearly completed.

During the year the work of construction was as follows:

The pneumatic dynamite battery of three 15-inch guns was completed; four emplacements for 12-inch guns practically completed at the end of last fiscal year were entirely completed; two have had their guns mounted, and two have the guns and carriages on hand; two new emplacements for 12-inch guns on disappearing carriages were started during the year and practically completed; six guns have been mounted in 8-inch emplacements; two emplacements for 8-inch guns completed, except setting the base ring; two emplacements for 6-inch rapid-fire guns on disappearing carriages completed, carriages mounted, but no guns; one emplacement for 5-inch rapid-fire gun on pillar mount carried as far as could be before mount is received; four emplacements for rapid-fire wire-wound guns and a battery for mounting sixteen 12-inch mortars, and five range-finder shelters of Type A completed.

At the torpedo station the keeper, with such small assistance as was found necessary, kept the station in good order during the year.

Racks for the storage of material were put into the torpedo shed.

The new cable tank and all connections for water supply and discharge were completed early in the fiscal year.

(See Appendix 3 V.)

Defenses of the mouth of the Columbia River.—Officer in charge, Capt. William C. Langfitt, Corps of Engineers, to June 21, 1900, and Capt. William W. Harts, Corps Engineers, since that date; assistant, Lieut. Amos A. Fries, Corps of Engineers, to September 29, 1899; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers.

With the new works are included two works of the old type, with two serviceable 15-inch smoothbore guns and two serviceable 8-inch converted rifles, mounted on front-pintle carriages.

At the close of the fiscal year ending June 30, 1899, four emplacements for 10-inch rifles on disappearing carriages, three emplacements for 8-inch rifles on disappearing carriages (one for experimental carriage not yet received), and one mortar battery of eight 12-inch rifled mortars on spring-return carriages had been turned over to the artillery. The work then completed and under construction was the 10-inch battery, the mortar battery, two electric-light stations, two mining casemates, one torpedo storehouse, two cable tanks, the 8-inch battery, two 6-inch and two 15-pounder batteries, and a wooden platform for 15-inch smoothbore gun.

During the fiscal year ending June 30, 1900, two emplacements for 10-inch rifles on disappearing carriages, A. R. F. (one carriage not yet received), four emplacements for 6-inch rifles on disappearing carriages, and four emplacements for 15-pounder rapid-fire guns, on balanced-pillar mounts (mounts not yet received), were turned over to the artillery. All completed gun emplacements have now been transferred to the artillery, but none of the electric-light plants.

From funds allotted from act of July 7, 1898, four emplacements for 6-inch guns on disappearing carriages and four emplacements for 15-pounder rapid-fire guns have been completed, except the electric-light plant, which is being installed.

Some additional details in connection with emplacements 5 and 6 of the 10-inch battery have been attended to, and the installation of the electric plant for 8-inch battery practically completed. The eight 12-inch rifled mortars were received by the artillery and mounted. One 10-inch carriage was mounted, and one remains to be mounted, not yet having been received. All four carriages for the 6-inch emplacements have been received by the artillery and mounted. The base rings were set by the Engineer Department.

Allotments have been made for two additional emplacements for 15-pounder rapid-fire guns, and a provisional allotment has also been made for two additional 6-inch emplacements.

None of the ordnance for 15-pounder emplacements has been received.

Two battery commanders' stations were completed and two sites for emergency type B range finders prepared.

Inspections required by General Orders, No. 1, Headquarters, Corps of Engineers, February 14, 1898, were made and the stored submarine mining material found to be in good condition. On instructions, requisition was submitted for additional material required for outlined project, nearly all of which has been received.

(See Appendix 3 W.)

Defenses of Puget Sound, Washington.—Officer in charge, Capt. Harry Taylor, Corps of Engineers; assistant, Lieut. Meriwether L.

Walker, Corps of Engineers; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers.

The defenses on Puget Sound are all of modern type.

At the close of the last fiscal year emplacements for four 10-inch guns and two 12-inch guns on nondisappearing carriages, for four 10-inch guns on disappearing carriages, and a mortar battery for sixteen 12-inch mortars had been constructed, and emplacements for five 10-inch guns and two 12-inch guns on nondisappearing carriages had been commenced. Plans had been prepared and approved for a mortar battery (No. 2) for sixteen 12-inch mortars and for three batteries of two 5-inch rapid-fire guns each. The excavation for mortar battery No. 2 had been advertised.

Three 10-inch and two 12-inch nondisappearing gun carriages and sixteen 12-inch mortar carriages had been mounted. There were on hand not mounted four 10-inch disappearing gun carriages, one 10-inch nondisappearing gun carriage, and two 12-inch and three 10-inch guns.

A storage basin for temporarily storing torpedo cable had been constructed.

During the year emplacements for five 10-inch guns and two 12-inch guns on nondisappearing carriages and a mortar battery (No. 2) for sixteen 12-inch mortars were practically completed, emplacements for four 5-inch rapid-fire guns on balanced-pillar mounts were completed as far as practicable until the receipt of the mounts, and emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts nearly completed. Emplacements for three 8-inch guns on disappearing carriages were commenced.

Plans were prepared and approved for emplacements for two 5-inch rapid-fire guns and for four 15-pounder rapid-fire guns.

Three 10-inch and two 12-inch guns on nondisappearing carriages, three 10-inch guns on disappearing carriages, and twelve 12-inch mortars were mounted. Four disappearing carriages and four nondisappearing carriages for 10-inch guns, one nondisappearing carriage for a 12-inch gun, and ten 12-inch mortar carriages were mounted.

A storehouse for the storage of torpedo material was partially built.

Title to sites on both sides of Rich Passage to Port Orchard was acquired.

There were turned over to the artillery troops during the year two 12-inch guns mounted on nondisappearing carriages, three 10-inch guns on disappearing carriages, three 10-inch guns on nondisappearing carriages, twelve 12-inch mortars, mounted, two 10-inch guns, not mounted, four 12-inch mortars, not mounted, one 10-inch disappearing carriage, mounted, one 10-inch nondisappearing carriage, partially mounted, and four 12-inch mortar carriages, mounted.

Plans and estimates were prepared for a mortar battery (No. 3) and for three emplacements for 10-inch guns on disappearing carriages, and estimates were prepared for three range-finder stations.

Plans for emplacements for two 6-inch rapid-fire guns on disappearing carriages were prepared, an allotment made, and part of the plant for carrying on the work was purchased. On account of the uncertainty regarding the carriage, no construction work was done. The plant will be available for building the emplacements for any type of carriage that may be finally adopted.

One 10-inch gun on disappearing carriage and four 12-inch mortars were mounted by the artillery troops.

Sixteen 12-inch mortars, two mortar carriages, and one 10-inch gun, not mounted, were on hand at the end of the year.

(See Appendix 3 X.)

EQUIPMENT OF ENGINEER TROOPS AND CIVILIAN ASSISTANTS TO ENGINEER OFFICERS.

By act of Congress approved March 3, 1899, the sum of $25,000 was appropriated for the equipment of engineer troops in the field, for the procurement of ponton trains, intrenching tools, instruments, drawing materials, etc., and the sum of $25,000 for civilian assistants to engineer officers serving on the staffs of division, corps, and department commanders, to enable them to secure the employment of surveyors, draftsmen, photographers, and clerks. Both appropriations are limited to the fiscal year 1900. Of the appropriation for the equipment of engineer troops there was allotted $21,470.88, leaving a balance of $3,529.12, which will revert to the Treasury. Of the appropriation for civilian assistants to engineer officers there was allotted $13,385, leaving a balance of $11,615, which will revert to the Treasury.

With the funds appropriated for the purposes above stated engineering supplies have been furnished, mainly through the Engineer Depot at Willets Point, N. Y., for the various military departments in the United States, the Philippines, Cuba, and Porto Rico, and the several engineer officers of important military commands and departments have been supplied with the necessary civilian assistants.

For the fiscal year ending June 30, 1901, the sum of $25,000 is appropriated by the army appropriation act of May 26, 1900, for each equipment of engineer troops and civilian assistants to engineer officers, and like sums are estimated as required for the next fiscal year.

For details of expenditures under these appropriations see Appendixes No. 4 and KKK.

ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1901–1902.

Fortifications.

For gun and mortar batteries:		
For construction of gun and mortar batteries	$4,560,000	
For installation of range and position finders	150,000	
		$4,710,000
For purchase of land for fortifications		500,000
For protection, preservation, and repair of fortifications		100,000
For preparation of plans for fortifications		5,000
For supplies for seacoast defenses		25,000
For sea walls and embankments		155,000
For filling in Fort Delaware Reservation		120,000
For torpedoes for harbor defense: For the purchase of submarine mines and necessary appliances to operate them, for closing the channels leading to our principal seaports, including San Juan, Porto Rico; for needful casemates, cable galleries, etc., to render it possible to operate submarine mines, and for continuing torpedo experiments		100,000
Total		5,715,000
For equipment of engineer troops		25,000
For civilian assistants to engineer officers		25,000

POST OF FORT TOTTEN, N. Y.

This post has continued under the command of Maj. John G. D. Knight, Corps of Engineers, and been garrisoned by headquarters, band, and Companies B, C, and D, Battalion of Engineers, and Battery N, Seventh Artillery. Company B left July 5, 1899, for Manila.

During the year $11,904.12 was allotted for repairs of buildings, roads, and walks, and of this sum all was expended except $1,804.86. Part of the allotment was for the next fiscal year.

An artillery barrack for 120 men is under construction.

New brick buildings are greatly needed to replace old frame officers' quarters in use since 1867, and for quarters for the noncommissioned post and battalion staff and band.

The artillery part of the garrison is insufficient for one relief for each of the guns and mortars forming the armament of the post. Should this artillery garrison be increased there will be need of additional barracks and quarters unless the Engineer Battalion be removed therefrom. Should the duties of submarine mining be transferred to the artillery, the main reason for the Battalion of Engineers remaining at Fort Totten will no longer exist.

UNITED STATES ENGINEER SCHOOL.

The engineer officer in command of the post of Fort Totten is the commandant of this school, and the captains commanding the engineer companies on duty at the post are the instructors.

A course of engineering, both practical and theoretical, is pursued for two years by officers assigned to the Corps of Engineers, commencing one year after they have been graduated at West Point.

Detailed programs of the course of instruction in military, electrical, and civil engineering are to be found in the report of the commandant.

The exigencies of the service necessitated the relief of seven officers before they had completed the course; sickness has interrupted the instruction of another; three remain under instruction, and have completed the first year's theoretical instruction.

Additions made to the library and the museum of the school so crowd the building set aside therefor that more space is needed. An addition to the building is recommended, and an estimate for the same is submitted.

BATTALION OF ENGINEERS.

During the year Company A has continued to serve in the Philippines; Company B has served there since August 13; Company C has served both at Camp Meade, Pa., and at Fort Totten; Company D at Fort Totten; and Company E at West Point, where it assists in the instruction of cadets in military engineering.

A detachment of enlisted men has been absent since February 13, 1900, on duty in connection with roadmaking in Alaska.

July 7, 1900, Company E was ordered to prepare for service in Manila, and to start not later than July 25.

The companies in Manila have performed the numerous duties of engineer soldiers and have also served as guards and outposts and on the firing line. Officers and enlisted men have received the commendations of high superior officers.

Details of the course of instruction of enlisted men of the battalion are given in the report of the commanding officer.

I renew my recommendation of last year that the number of cooks for an engineer company be increased to two, each to have rank and pay as now provided by law for one.

Other companies of the line whose maximum strengths do not exceed 120 men are by law entitled to two cooks, while an engineer company, of a maximum strength of 150, is entitled to but one.

ENGINEER DEPOT.

Tools and materials for submarine-mining defenses, bridge equipments, and field engineering, including surveying and photographic outfits, have been issued during the year for use of engineer and acting engineer officers, and hygrometric instruments have been furnished for outfit of fortifications.

Additions have been made to the advance and reserve guard bridge train. It has been found necessary to substitute Oregon pine for white, for use as long balks.

Officers in charge of submarine-mining defenses having, under orders from this office, prepared lists showing material needed to complete the various defenses, these lists have been recorded at the depot, and shipments to the various harbors, of material in stock and purchased, have commenced. About 145 tons had been shipped by the close of the year.

An estimate of the cost of all submarine-mining materials still to be purchased has been prepared.

During the year $10,820.60 was applied to the purchase and supply of articles pertaining to the equipment of engineer troops.

Company B, Battalion of Engineers, was fitted out with tools and materials for service in the Philippines, and two divisions of advance guard bridge train were sent to the chief engineer officer at Manila.

STATEMENT OF FUNDS.

Congress has appropriated as follows:

I. For Engineer Depot at Willets Point, N. Y., for fiscal year ending June 30, 1899:	
July 1, 1899, balance unexpended	$19,367.03
June 30, 1900, withdrawn and turned in	13,940.00
June 30, 1900, amount expended during fiscal year	4,077.03
July 1, 1900, balance unexpended and pledged	1,350.00
II. For Engineer Depot at Willets Point, N. Y., for fiscal year ending June 30, 1900	10,000.00
June 30, 1900, amount expended during fiscal year	9,246.91
June 30, 1900, amount pledged	419.92
III. Torpedoes for Harbor Defense:	
1. Act August 18, 1890, for "torpedo experiments," etc.—	
July 1, 1899, balance unexpended	359.03
June 30, 1900, expended during fiscal year	359.03
2. Act March 3, 1897, for "purchase of submarine-mining materials," etc.—	
July 1, 1899, balance unexpended	1,471.40
June 30, 1900, expended during fiscal year	1,471.40

3. Act March 3, 1899, for "torpedo experiments"—		
July 1, 1899, balance unexpended		$5,000.00
July 1, 1900, balance available		2,706.04
4. Act March 3, 1899, for "purchase of designated classes of torpedo material"—		
July 1, 1899, balance unexpended		34,000.00
July 1, 1900, balance available		1,051.66
5. Act July 7, 1898, torpedoes for Harbor Defense, January 1, 1899—		
July 1, 1899, balance unexpended		219.55
June 30, 1900, turned into Treasury during the year	$180.23	
June 30, 1900, expended during the year	39.32	
		219.55
IV. Equipment of Engineer Troops, January 1, 1899:		
1. Act July 7, 1898, for "intrenching tools"—		
July 1, 1899, balance unexpended		13.37
June 30, 1900, expended during fiscal year		13.37
Equipment of Engineer Troops, 1899:		
2. Act January 5, 1899, for "instruments," etc.—		
July 1, 1899, balance unexpended		1,169.29
June 30, 1900, withdrawn and turned in during fiscal year	$70.09	
June 30, 1900, expended during fiscal year	1,099.20	
		1,169.29
Equipment of Engineer Troops, 1900:		
3. Act March 3, 1899, for "instruments," etc.—		
June 30, 1900, total for all allotments received during fiscal year, and by transfer from allotment for "ponton trains"		8,961.31
July 1, 1900, balance available		29.40
4. Act March 3, 1899, for "fitting out ponton trains"—		
October 17, 1899, amount allotted		3,800.00
July 1, 1900, balance unexpended and pledged		906.91
V. Preservation and repair of fortifications:		
Act March 3, 1899, for "purchase of hygrometers and thermometers"—		
April 24, 1900, amount allotted		1,000.00
July 1, 1900, balance available		415.36

NEW APPROPRIATIONS.

For Engineer Depot at Willets Point, N. Y., for fiscal year ending June 30, 1901	$10,000.00

ESTIMATES.

There will be required for the fiscal year ending June 30, 1902, for the Engineer Depot at Willets Point, N. Y., the following:

For incidental expenses of depot	$5,000.00
For purchase of materials for use of United States Engineer School and for instruction of engineer troops	1,500.00
For purchase and repair of instruments	3,000.00
For purchase and binding of professional works for library of United States Engineer School	500.00
For an addition to the building containing engineering models and library of the United States Engineer School, to be available until expended	12,000.00
Total	22,000.00

(See Appendix No. 4.)

RIVER AND HARBOR IMPROVEMENTS.

Appropriations.—The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations made by the deficiency act approved January 5, 1899; the sundry civil act approved March 3, 1899; the river and harbor act approved March 3, 1899; the sundry civil act approved June 6, 1900, and from such balances of former appropriations as were available.

Emergency river and harbor act.—This act became a law June 6, 1900. It provides for certain examinations and surveys, for diversions of funds in a few special localities, and, in addition, for the restoration of channels in cases of emergency and under certain conditions. Allotments from funds provided by this act have been made in such cases as came within the restrictions of the law.

Status of works.—Statements derived from the reports of the officers in charge of the various works, and given herewith, set forth the condition of each improvement and the extent of the work performed during the last fiscal year.

Expenditures.—The total amount actually expended in connection with the improvement of rivers and harbors during the fiscal year ending June 30, 1900, is as follows:

Rivers and harbors (general, including examinations, surveys, and contingencies)	$13,912,207.81
Removing sunken vessels	73,220.34
Operating snag and dredge boats on Upper Mississippi River	24,944.00
Removing obstructions in Mississippi River	86,355.29
Gauging waters of Lower Mississippi River and its tributaries	5,470.19
Examinations and surveys at South Pass, Mississippi River	9,107.87
Mississippi River Commission	2,990,586.79
Missouri River Commission (including Osage and Gasconade rivers)	373,690.26
Operating snag boats on Ohio River	37,079.05
Operating and care of canals, etc	847,819.84
Prevention of deposits in New York Harbor	110,931.91
California Débris Commission	13,884.99
Total	18,485,298.34

This amount does not include the following:

(1) $125,000 paid to the James B. Eads estate for "maintaining jetties and other works at South Pass, Mississippi River."

(2) $61,042.97 disbursed under the direction of the Secretary of War on account of "surveys and examinations of waterways between the Great Lakes and the Atlantic Ocean."

Estimates.—The total estimate submitted by the Chief of Engineers for the fiscal year ending June 30, 1902, for continuous work authorized by Congress is $8,751,317.86. For the construction and maintenance of works authorized by Congress, but not provided for by continuing contracts, estimates are submitted as follows:

Rivers and harbors (general)	$20,000,000
Examinations, surveys, and contingencies	200,000
Under Mississippi River Commission	3,890,000
Under Missouri River Commission	1,040,000
Under California Débris Commission	15,000
Prevention of deposits in New York Harbor	72,800

The river and harbor act approved March 3, 1899, provides that appropriations made for the works therein named may be used, in the discretion of the Secretary of War, for the repair and restoration of such works, as well as for their further improvement, and estimates are submitted for repair and maintenance, as well as for continuing or completing improvements.

Discontinuance of appropriations and deterioration of works.—The river and harbor act approved March 3, 1899, also requires that the Chief of Engineers submit recommendations, with reasons therefor, as to the discontinuance of appropriations for any river or harbor work that he may deem unworthy of further improvement. Such recommendations, together with report on deterioration, are submitted in Appendix B B B.

Operating and care of canals, etc.—Under the provisions of law the operation, care, and maintenance of certain public works is provided for by the permanent-indefinite appropriation of July 5, 1884.

Occupancy of piers, wharves, etc.—A report of piers, wharves, and other structures or property pertaining to river and harbor works belonging to the Government of the United States now occupied by private corporations or persons, together with terms upon which they are occupied, and other information, as required by section 8 of the river and harbor act approved March 3, 1899, is given in Appendix C C C. Information of a similar character is called for by section 2 of the river and harbor act approved July 5, 1884, and by section 4 of the river and harbor act approved August 5, 1886.

Removal of wrecks.—Reports are appended of work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in sections 19 and 20 of the river and harbor act approved March 3, 1899.

Establishment of harbor lines.—Under authority given to the Secretary of War in section 11 of the river and harbor act approved March 3, 1899, harbor lines have been established during the past fiscal year at the following localities, details of which will be found in the reports of the local officers: Rockland Harbor, Maine; Charles River, at Cambridge, Mass.; Mount Hope Bay, at Fall River, Mass.; Thames River, at New London, Conn.; New Haven Harbor, Connecticut; Stamford Harbor, Connecticut; East River, from Oak Point to Bronx River, New York City; East River from Thirty-seventh to Thirty-eighth street, New York City; Jersey flats, on west side of Upper New York Bay, opposite Greenville, N. J.; Baltimore Harbor and Patapsco River, Maryland; Curtis Bay, Baltimore Harbor, Maryland; James River, at Richmond, Va.; Elizabeth River, at Norfolk, Va.; Trent and Neuse rivers, at Newbern, N. C.; Hillsboro River, at Tampa, Fla.; St. Georges Sound, at Dog Island, Florida; Galveston Harbor, at Fort San Jacinto, Tex.; San Jacinto Bay, at Laporte, Tex.; harbor at Duluth, Minn., and Superior, Wis.; Kenosha Harbor, Wisconsin; Buffalo Harbor, New York; Niagara River, at North Tonawanda, N. Y.; Willamette River, at Portland, Oreg.; Honolulu Harbor, Hawaiian Islands (see Appendix D D D).

Bridges.—Examinations were made during the year, whenever required by the committees of Congress, of bills authorizing the construction of bridges, and for other purposes, upon which the views of the War Department were desired.

A report of a Board of Engineers appointed to consider and report upon H. R. bill 1065, Fifty-sixth Congress, first session, providing for the construction of bridges across the Ohio, Monongahela, Mississippi, Kanawha, Tennessee, Cumberland, and Illinois rivers, is submitted herewith as Appendix E E E.

During the fiscal year examinations were made of such plans and locations as were submitted by parties interested, of bridges proposed to be built over navigable waters, subject to the approval of the Secretary of War. A brief statement is given of the action had in such cases.

Under sections 4 and 5 of the river and harbor act approved September 19, 1890, and section 18 of the river and harbor act approved March 3, 1899, persons, corporations, or associations owning or controlling bridges over navigable waterways of the United States which are unreasonable obstructions to the free navigation of such waters, after being given a reasonable opportunity to be heard, have been notified so to alter the bridges as to render navigation through or under them reasonably free, easy, and unobstructed. In each case the changes required to be made were specified in the notice, and a reasonable time was prescribed in which to make them. A detailed statement of the cases is given further on in this report.

South Pass of the Mississippi River.—The required channel was maintained during the year through the shoal at the head of South Pass, through the pass itself, and through the jetties, except for nineteen days. If there be no further periods of nonmaintenance of channel, the twenty years during which James B. Eads and his successors are under contract to maintain a channel at the South Pass will expire January 28, 1901. In anticipation of such expiration the sundry civil act approved June 6, 1900, provided an appropriation of $500,000 for payment to the legal representatives of Mr. Eads of the second moiety of $1,000,000 retained under the provisions of the act approved March 3, 1875. The emergency river and harbor act approved June 6, 1900, also made provision for the termination of the contract with Mr. Eads at any time previous to its expiration, and for the purchase of contractor's plant, action under this law to be taken at the discretion of the Secretary of War. The matter is having the consideration of the Secretary. The last-mentioned act also provides that upon the termination of the contract by expiration, or in accordance with the provisions of this law, the Secretary of War shall take charge of South Pass channel and maintain it with utmost efficiency; and he is authorized, until the work is otherwise provided for by law, to draw his warrant on the Treasurer of the United States for such sums as may be necessary, not to exceed $100,000 in the aggregate in any one year.

Construction of hydraulic dredges.—The river and harbor act approved March 3, 1899, as amended by the sundry civil and the emergency river and harbor acts approved June 6, 1900, provides for the construction of one hydraulic dredge for the passes of the Mississippi River, and it is anticipated that provision will be made for a second dredge for the same locality. The construction of other dredges was also provided for. The subject of hydraulic-dredge construction was taken under consideration by Col. Henry M. Robert, Corps of Engineers, and, later, the duty of preparing plans and specifications for the Mississippi River dredges and the consideration of plans for other dredges was assigned to Maj. Thomas H. Handbury, Corps of Engineers. Plans and specifications for one of the Mississippi River dredges have been completed, and details for the second dredge are being prepared.

Chicago Drainage Canal.—In April, 1899, the trustees of the Sanitary District of Chicago requested a permit from the Secretary of War to connect the drainage canal with the West Fork of the South Branch of the Chicago River. On May 8, 1899, the Secretary of War granted a conditional permit to the Sanitary District of Chicago to connect its artificial channel with the Chicago River and cause the waters of said river to flow into the canal. The permit was granted on the representation that such movable dams and sluice gates had been constructed by the Sanitary District of Chicago as will at all times secure absolute and complete control of the volume and velocity of flow through the Chicago River, and on the following conditions:

1. That it is distinctly understood that it is the intention of the Secretary of War to submit the questions connected with the work of the Sanitary District of Chicago to Congress for consideration and final action, and that this permit shall be subject to such action as may be taken by Congress.

2. That if at any time it become apparent that the current created by such drainage works in the South and main branches of the Chicago River be unreasonably obstructive to navigation or injurious to property, the Secretary of War reserves the right to close said discharge through said channel, or to modify it to such extent as may be demanded by navigation and property interests along said Chicago River and its South Branch.

3. That the Sanitary District of Chicago must assume all responsibility for damages to property and navigation interests by reason of the introduction of a current in Chicago River.

In accordance with the permission granted, the sanitary trustees made a connection during the past year between the drainage canal and the West Fork of the Chicago River, and the waters now run to the west, the river taking its original supply from Lake Michigan and discharging through the canal into the Des Plaines and Illinois rivers. As a result of the reversing of the current and the increasing of its strength some accidents have occurred, and requests for a regulation of the flow in the interest of navigation have been made. No action further than to require a close observation and reports of results has yet been considered necessary. The trustees of the Sanitary District are undertaking the enlargement of the waterway of the Chicago River, with a view of providing for the full discharge required by State law without causing such current as will injure the interests of navigation. Even should such results be accomplished there will still remain the question of the effect upon the lake levels by the abstraction of water from Lake Michigan.

The question of drawing water from Lake Michigan through the Chicago River and the drainage canal, in the interest of the drainage system of Chicago, is one of great importance to that city and district, but there are also questions involved of equally great importance to the lake navigation interests both of the United States and Canada. It is very probable that all these interests can not be fully satisfied and that there must be a compromise effected. The question has been temporarily settled by the granting of a temporary permit, which can only be considered as a permit to experiment so long as no serious results follow. It would appear that consideration by Congress of the questions involved is of the utmost importance with a view to reaching an ultimate settlement as soon as practicable. The probable effect on the lake levels can not now be determined. A Board of Engineers, consisting of Col. O. M. Poe, Maj. E. H. Ruffner, and Maj. W. L. Marshall, Corps of Engineers, gave consideration to this question in 1895, and expressed the opinion that a lowering would result, but that the data available were not sufficient to determine the effect of the proposed discharge. It is understood that investigations and observations made under the direction of the Deep Waterways Commission and by others may furnish data upon which further consideration of the question may be based.

Pearl Harbor, Hawaii.—The act approved March 3, 1899, appropriated $100,000 for the improvement of Pearl Harbor in accordance with the report submitted in Senate Ex. Doc. No. 42, Fifty-third Congress, third session. In advance of the preparation of a project for the work, the Secretary of War, on March 13, 1899, requested of the Secretary of the Navy such information as might be available regarding the proposed improvement, and such recommendations as might be thought proper respecting the special requirements considered desirable for naval purposes. To comply with the recommendations of the Secretary of the Navy, the Secretary of War directed that the work be postponed. Under date of July 14, 1900, the Secretary of War directed that the work be begun as provided for by Congress. An officer of Engineers has been assigned to the work, and arrangements will be made for its commencement at the earliest date practicable.

Memorial bridge and boulevard to connect the capital of the nation with the tomb of Washington, at Mount Vernon, Va.—Congress has given much favorable consideration to the construction of a memorial bridge across the Potomac River to the national cemetery at Arlington, and consideration has also been given to a national boulevard connecting Arlington with Mount Vernon. Several reports with plans and approximate estimates have been submitted since 1886 by officers of the Corps of Engineers in response to calls by Congress. Inviting attention to the reports heretofore presented, I earnestly recommend Congressional action looking to the early commencement of these great enterprises—the memorial bridge and the boulevard.

In accordance with the provisions of the sundry civil act approved March 3, 1899, and by authority of the President of the United States and the Secretary of War, four eminent bridge engineers submitted competitive designs for a bridge combining the elements of strength and durability and such architectural embellishment and ornamentation as will fitly apply to the dedication, "A memorial to American patriotism." The report of a Board of Officers of the Corps of Engineers and of Architects, appointed by order of the Secretary of War, to consider and report upon the relative merits of the designs, was submitted March 28, 1900, and is printed in House Doc. No. 578, Fifty-sixth Congress, first session. It is herewith in Appendix F F F 2.

Regulations governing the running of loose logs, steamboats, etc., on certain streams.—An act of Congress approved May 9, 1900, removes all streams of the United States on which the running of loose logs is the principal method of navigation from the provisions of section 15 of the river and harbor act approved March 3, 1899, and provides that the Secretary of War shall prescribe regulations for all classes of navigation on such streams. Regulations have been so established, as follows: St. Croix River, Minnesota and Wisconsin; Mississippi River from mouth of Chippewa River to head of West Newton Slough, and

Sabine River, Louisiana and Texas. A large number of rivers is included in the class excepted from the law of 1899, and different regulations, based upon the varying conditions, will be required for each river. Detailed investigation will be necessary to determine the condition in each case and to insure as nearly as possible an equitable adjustment of conflicting interests, as required by the new law. While the change in the law will throw much labor and responsibility on the War Department, it is not anticipated that the results will in the end prove any more satisfactory to all the conflicting interests than those that were obtained under the original law.

Engineer divisions.—The engineering works in the charge of this office are arranged in five divisions and officers of the Corps of Engineers are assigned as division engineers to overlook these works, as follows:

West of the Rocky Mountains: Pacific Division, Col. S. M. Mansfield. East of the Rocky Mountains: Northeast Division, Col. G. L. Gillespie; Southeast Division, Col. Peter C. Hains, to July 8 and since October 27, 1899; Southwest Division, Col. Henry M. Robert; Northwest Division, Col. J. W. Barlow.

Aid to injured employees.—Some action, it seems to me, is necessary on the part of Congress to place it within the power of the Secretary of War to authorize the expenditure of a reasonable amount in extending aid to persons injured while in the employ of the United States, and I earnestly recommend that the subject receive careful consideration and such favorable action as in the judgment of Congress may be deemed equitable.

Sale of personal property no longer needed.—I renew my recommendation of February 13, 1899, concerning the necessity for legislation by Congress authorizing the disposition by sale of personal property, such as horses, mules, dredges, tugs, etc., purchased for use in connection with river and harbor improvements and no longer needed, although in good and serviceable condition.

The following is a draft of a proposed law conferring such authority on the Secretary of War, so far as river and harbor works are concerned, and its enactment is suggested:

> SEC. -. That any personal property purchased by the United States for use in connection with works of river and harbor improvement which is no longer needed for any such purpose may, in the discretion of the Secretary of War, be disposed of at public sale, after due advertisement, the proceeds of such sale to be deposited in the Treasury to the credit of miscellaneous receipts.

The correspondence on this subject is printed in House Doc. No. 263, Fifty-fifth Congress, third session.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE, EAST OF AND INCLUDING PORTLAND HARBOR.

This district was in the charge of Maj. S. W. Roessler, Corps of Engineers, having under his immediate orders Lieut. (now Capt.) Charles Keller, Corps of Engineers, to September 30, 1899, and Lieut. Thomas H. Jackson, Corps of Engineers, the entire year. Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

1. St. Croix River, Maine.—In 1855 and 1857 three piers were built in this river at the Ledge, 3½ miles below Calais, under the supervision of the Light-House Establishment, with funds appropriated for light-house purposes. In 1881 the piers were repaired under the supervision of the War Department with funds provided by the river and harbor act of March 3, 1881. The purpose for which these structures were built was partly to serve as a beacon marking the Ledge, but mainly to serve as a breakwater to ward off boats from the Ledge. It has been submitted by the Light-House Board, through the Treasury Department, that the work pertains especially to the river improvement, and should be supervised and maintained by the War Department in connection with the improvement of said river. The piers are in need of repair, but it does not appear permissible for the War Department to relieve the Treasury Department of the supervision of the work and adopt it as an authorized river and harbor work without further authority from Congress, and even should such supervision be assumed no funds are now available which could be applied to the work. It is estimated by the engineer of the First light-house district that the sum of $150 is needed for immediate work, but to thoroughly repair the piers a much larger sum would probably be required. An estimate of cost for needed repairs will be prepared when an opportunity is offered to secure the necessary information.

2. *Lubec Channel, Maine.*—This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada.

Originally the channel was but 5 feet in depth at mean low tide and but 2 feet at low water of spring tides. A project was adopted in 1879 which, as subsequently modified, provided for a channel 275 feet wide, increasing to 300 feet in the bends, and 12 feet deep at mean low tide. This project was completed in 1890, practically as proposed, at a cost of $168,954.68. In 1894 a new project was adopted which provided for widening the existing channel to a least width of 500 feet, with a depth of 12 feet at mean low tide. The work covered by the new project has been estimated to cost $150,000.

The expenditures to June 30, 1899, amounted to $239,949.75 ($168,954.68 on the old project and $70,995.07 on the new). At that date the channel dredged under the project of 1879 had been widened about 170 feet at the entrance and about 190 feet at the turn just above Cranberry Point. The most difficult and expensive part of the work (that in the narrows) was completed.

Dredging under contract with Augustus R. Wright was commenced June 22, 1900, in continuation of the widening of the entrance channel, and up to the close of the fiscal year 9,150 cubic yards of material had been removed. Work under this contract will probably be completed during the present working season, and, to complete the improvement as projected, there will then remain to be dredged a strip, averaging about 130 feet in width and about 3,500 feet in length, on the easterly side of the lower part of the channel.

This channel is an international passage and the benefits resulting from the improvement are almost entirely general. As the tidal currents are very strong and dense fogs prevail a large part of the time, the widening of the channel decreases the chances of stranding and collisions.

From the best information obtainable other than from a survey, the dredged depth of 12 feet at mean low tide seems to hold well and this depth governs the draft of vessels using the channel.

The commerce is reported as follows:

	Tons.
1896	52, 300
1897	53, 400
1898	87, 000
1899	126, 700

July 1, 1899, balance unexpended		$26,050. 25
June 30, 1900, amount expended during fiscal year		97. 04
July 1, 1900, balance unexpended		25,953. 21
July 1, 1900, outstanding liabilities	$108. 55	
July 1, 1900, amount covered by uncompleted contracts	24,000. 00	
		24,108. 55
July 1, 1900, balance available		1,844. 66
Amount (estimated) required for completion of existing project		53,000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		51,000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 1.)

3. Moosabec Bar, Maine.—Before improvement the entrance at the eastern end of Moosabec Reach was difficult, the channel being crooked, with ledges on either hand. The direct entrance was obstructed by a bar on which the depth was less than 6 feet at mean low tide.

A project adopted in 1881 provided for a channel 14 feet deep at mean low tide and not less than 200 feet wide through the bar at the eastern entrance to the reach. October 30, 1888, this project was amended to cover the widening of the 14-foot channel to 300 feet, the removal of ledges obstructing the channel, and the construction of a small breakwater to divert cross currents. The estimated cost of the project is $114,000.

The expenditures to June 30, 1899, were $102,529.95. At that date the 300-foot channel had been completed, the breakwater had been built, and 2,967 cubic yards of ledge had been removed.

The expenditures during the fiscal year 1900 were $11,470.05. Under contract with Harries & Letteney, dated July 10, 1899, 748.5 cubic yards of ledge was removed from the westerly approach to the dredged channel. This work was commenced August 4, 1899, and finished September 30, 1899, thereby fully completing the entire project of improvement.

The draft of vessels passing through Moosabec Reach is practically limited by the depth of the dredged channel, that is, 14 feet at mean low tide.

The benefits of this improvement are entirely general, as the reach, being a sheltered thoroughfare, is used as such extensively by coastwise vessels, and also to a considerable extent as a harbor of refuge.

While undoubtedly a gradual shoaling of the channel will take place through the same causes that created the original bar, it is thought probable that the deposit of sand and silt will be so slow that its removal may safely be left to be provided for when the necessity arises.

The deputy collector of customs at Jonesport, Me., estimated that about 2,750 vessels passed through the reach during the calendar year 1897, about 3,075 during 1898, and 2,500 during 1899.

July 1, 1899, balance unexpended	$11,470. 05
June 30, 1900, amount expended during fiscal year	11,470. 05

(See Appendix A 2.)

4. *Narraguagus River, Maine.*—The obstruction to navigation consisted in a bar at the mouth of the river, over which there was a navigable depth of less than 6 feet at mean low tide.

The approved project, adopted in 1886, is to dredge a channel not less than 200 feet wide, having a depth of 11 feet at mean low tide up to Long Point and a depth of 9 feet thence to the "Deep Hole;" estimated cost, $50,000.

The expenditures to June 30, 1899, for improvement below Millbridge, amounted to $44,403.06. At that date the channel had been dredged to the full width of 200 feet up to the old steamboat wharf, with turning basins about 300 feet in width each in front of both the old and the new steamboat wharves.

A survey was made in November, 1899, which showed that considerable filling had taken place, especially in the turning basin at the new steamboat wharf and in the channel immediately below. With the approval of the Chief of Engineers, a contract was made to redredge this turning basin and part of the channel to 11 feet at mean low tide. Work was begun May 31 and completed June 16, 1900, 30,000 cubic yards of material (mostly sawdust and mud) being removed. At the present time there is no traffic above the new steamboat wharf which a dredged channel would benefit. The project is therefore regarded as completed, and no further appropriation is asked for at the present time.

The passing in and out of the steamboat, which lands at the new steamboat wharf four times weekly, maintains the depth in the entrance channel fairly well, but filling in the turning basin will probably occur while existing conditions remain unchanged, and more especially as long as sawdust and other mill waste are deposited in the river. The draft of the steamboat is between 9 and 10 feet.

The commerce for the last seven years is given as follows:

	Tons.		Tons.
1893	60,875	1897	41,500
1894	95,600	1898	26,147
1895	54,750	1899	23,545
1896	16,175		

July 1, 1899, balance unexpended	$5,596.94
June 30, 1900, amount expended during fiscal year	5,032.90
July 1, 1900, balance unexpended	564.04
July 1, 1900, outstanding liabilities	52.50
July 1, 1900, balance available	511.54

(See Appendix A 3.)

5. *Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Maine.*—The anchorage in front of the town of Bar Harbor, as well as the wharves at which steamers land, is exposed to storms and seas from southerly directions, at times rendering the anchorage insecure and the landing of passengers and freight at the wharves difficult. The original project was to construct a riprap breakwater on a direct line from Porcupine Island to Dry Ledge, and thence to within a short distance of Mount Desert Island.

December 17, 1890, the Secretary of War approved a slight change in the direction of that portion west of Dry Ledge, the alteration bringing the westerly end of the breakwater somewhat farther to the southward.

In January, 1893, by authority of the Secretary of War, the project was again amended, and now provides for a breakwater on the direct line first proposed, but somewhat shorter, terminating at a distance of about 600 feet from the low-water line on Mount Desert Island. The estimated cost of the present project is $420,200.

The expenditures to June 30, 1899, were $169,490.60, at which date the breakwater had been completed for a distance of 666 feet west of Dry Ledge. The total projected length of that portion west of the ledge is 1,440 feet.

Under contract with William S. White the work of depositing stone on and in continuation of the breakwater was begun April 28, and at the end of the fiscal year 13,898 tons of stone had been furnished and placed in the work. Most of the stone has been used in raising to full height and section the part of the old work which had settled or been lowered by the action of the waves. The length of the breakwater as built west of Dry Ledge is about 700 feet, leaving 740 feet yet to be built.

The beneficial effects resulting from the portion of the breakwater already built in protecting the wharves at Bar Harbor and the anchorage basin are very appreciably felt.

The breakwater will require more or less extensive repairs until the side slopes have assumed an angle of rest against wave action.

The benefits to navigation are general in providing a harbor of refuge, and local in making it possible for boats to land at the wharves at all times with safety. The only practicable method of transportation to and from Bar Harbor is by boat.

The commerce for 1898 was reported as 22,175 tons; for 1899 it has been estimated as 24,393 tons.

July 1, 1899, balance unexpended		$20,509.40
June 30, 1900, amount expended during fiscal year		5,504.17
July 1, 1900, balance unexpended		15,005.23
July 1, 1900, outstanding liabilities	$729.07	
July 1, 1900, amount covered by uncompleted contracts	12,709.26	
		13,438.33
July 1, 1900, balance available		1,566.90
Amount (estimated) required for completion of existing project		230,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix A 4.)

6. *Harbor at Sullivan Falls, Maine.*—Sullivan River has a length of about 6 miles, and is the outlet of a large bay. About midway of its length a point of land projects to such extent as to reduce the width to about one-fourth that immediately above and below, and at this place the slope and velocity are such that the locality is termed Sullivan Falls. The bottom is ledge, the higher portions forming dangerous obstructions to navigation. Hatchers Rock, about midway of the narrow channel at the falls, had originally only about 6 inches of water over it at mean low tide.

Under a project completed in 1875, the sum of $35,000 was expended in removing three old piers, in excavating the obstructing ledges at the falls to a depth of 7 feet at mean low tide, and in placing spindles on two rocks near the mouth of the river. This work was of material benefit to navigation.

Under the act of 1890, an examination was made of Sullivan Falls, and a new project, estimated to cost $35,000, for removing Hatchers Rock and two other points of ledge to a depth of 10 feet at mean low tide was submitted. The first appropriation for work under this last project was by act of June 3, 1896.

The expenditures under the existing project to June 30, 1899, were $4,834.11, and the operations consisted in removing nearly the entire area of Hatchers Rock to a depth of 10 feet at mean low tide.

Removal of ledge by contract, in continuation of improvement was begun in August, 1899, and completed October 25, 1899, during which time 184.3 cubic yards of ledge was removed. The removal of Hatchers Rock to a depth of 10 feet at mean low tide was completed and a part of the outer end of Ledge "C" was taken off to the same depth.

The improvement not only increases the navigable depth, but also, by removing the cause of eddies and cross currents, has added to the length of time at each high and low tide during which vessels may pass through the rapids with safety.

The improvement may be regarded as permanent.

The commerce for 1896 is given as 51,290 tons; for 1897 as 50,790 tons; for 1898 as 41,700 tons, and for 1899 as 42,125 tons.

July 1, 1899, balance unexpended	$5,165.89
June 30, 1900, amount expended during fiscal year	4,701.20
July 1, 1900, balance unexpended	464.69
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 5.)

7. *Union River, Maine.*—Originally the channel of Union River was much obstructed, and in the upper part almost closed, at low tide. Under a project, completed in 1873, the sum of $30,000 was expended in removing a large quantity of mill waste, ledge, and bowlders, giving a depth of 3 to 4 feet at mean low tide up to the head of navigation at Ellsworth.

A survey of Union River and Bay was made under the act of 1888, and a project was submitted for obtaining a channel through the bar at the mouth of the river by the construction of a jetty, and for a depth of 6 feet at mean low tide in the upper part of the river by dredging. The total cost was estimated at $225,000, about $145,000 of which was for dredging. It was found that the channel was again filling with mill waste. The first appropriation since this survey was by the act of June 3, 1896, which appropriated $15,000 for improving Union River by dredging.

The total expenditures to June 30, 1899, for work on this river were $45,124.87. At that date the channel had been dredged to the depth of 6 feet at mean low tide to a point about 3,000 feet from its lower end, working upstream, but a section of about 1,000 feet, where harder material was encountered, was not down to grade, also a single cut, 3 feet deep at mean low tide, had been dredged from this point up to the wharves at Ellsworth, with a view to affording a measure of immediate relief to commerce. The officer in charge reports that the dredged channel has filled up again and been practically obliterated.

By the act of March 3, 1899, the sum of $15,000 was appropriated, and the improvement placed under the continuous-contract system.

The item reads as follows:

> Improving Union River, Maine: Continuing improvement, fifteen thousand dollars: *Provided*, That the Secretary of War may enter into contract or contracts for such material and work as may be necessary to complete the present project, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate one hundred and fifteen thousand dollars, exclusive of the amount herein and heretofore appropriated.

This item evidently referred to the report and estimate submitted in compliance with the river and harbor act of August 11, 1888, with the training wall at the mouth of the river therein proposed omitted. As this change would necessitate dredging at the mouth of the river, and as the discovery of ledge in the proposed channel and the probability of additional filling had changed the conditions then existing, a new survey was considered necessary. This survey was made in May, 1899, and report with maps and estimates submitted June 16, 1899 (see Annual Report of the Chief of Engineers for 1899, pp. 1026 et seq.).

The estimate then submitted was to obtain entirely by dredging and ledge excavation a channel 6 feet deep at mean low water, with width in straight sections varying from 200 feet to 100 feet, from the mouth of the river to the wharves at Ellsworth. This estimate for expenditure of funds for completion of the improvement was approved by the Secretary of War, June 28, 1899.

A contract for completion of the entire work was made with Augustus R. Wright, October 16, 1899. This contract required that the expenditure of the $15,000, made available by the river and harbor act of March 3, 1899, should be applied to dredging a channel through the bar of sawmill waste near the head of navigation, said channel to be of smaller dimensions but embraced within the limits of the channel when completed in accordance with the approved plan of improvement, and that this part of the work should be completed on or before August 1, 1900. Dredging of this channel is now in progress, but owing to late freshets was not commenced until May 26, 1900.

As the balance of the funds ($115,000) necessary for the completion of the whole improvement was appropriated by the sundry civil act of June 6, 1900, it was recommended June 29, 1900, that the completion of this smaller channel separately, both as to manner of doing the work and time of completion, be abandoned and the whole work carried on under the general terms of the contract, the time of completion being not later than December 31, 1901. This recommendation was approved by the Chief of Engineers, July 6, 1900.

Work was begun May 26, 1900, and from that time to the close of the fiscal year 10,938 cubic yards of material, almost entirely slabs, edgings, and sawdust, was removed from a section of channel 90 feet wide, about 900 feet long, and about 4 feet deep, beginning a short distance above the narrows and working upstream.

The progress of the dredging is very slow and the ledge excavation has not been commenced.

The benefits of the improvement will be in giving more economical facilities for shipping to and from Ellsworth by water, principally coal in, and sawmill products out.

The improvement can not be regarded as permanent, as the masses of slabs and edgings and sawdust now within the banks of the river will gradually work into the channel and necessitate redredging. At the mills on the river, above the head of navigation, all the short sawdust and a part of the other waste materials go into the stream.

The draft of vessels using the river will be governed by the channel depth which obtains when the improvement is completed.

The commerce for 1896 is given as 54,000 tons; for 1897 as 57,685 tons; for 1898 as 50,462 tons, and for 1899 as 49,800 tons.

July 1, 1899, balance unexpended		$14,875.13
Amount appropriated by sundry civil act approved June 6, 1900		115,000.00
		129,875.13
June 30, 1900, amount expended during fiscal year		587.19
July 1, 1900, balance unexpended		129,287.94
July 1, 1900, outstanding liabilities	$307.50	
July 1, 1900, amount covered by uncompleted contracts	119,890.00	
		120,197.50
July 1, 1900, balance available		9,090.44

(See Appendix A 6.)

8. *Bagaduce River*, *Maine*.—This is a small stream that empties into Penobscot Bay at Castine, Me. The upper part of the river divides into two branches, one called Northern Bay and the other South Bay. Northern Bay near South Penobscot is a shoal sheet of water of about 700 acres area, the bottom of which for the greater part is bare at low tide. There was a narrow channel from Bridges Point to Bowden's wharf which had a depth of less than 2 feet and was obstructed by ledges and bowlders near Winslows Island. The South Bay is obstructed by ledges at Johnsons Narrows. A project for the improvement of the Northern Bay was adopted in 1890 which has for its object the securing of a channel 100 feet wide and 6 feet deep at mean low tide from Bridges Point to Bowden's wharf, at an estimated cost of $45,000. It is also intended to remove a small quantity of rock obstructing the channel at Johnsons Narrows, at an estimated cost of $1,875.

The expenditures to June 30, 1899, were $21,790.18. At that date the channel had been dredged its entire length for a width of 40 feet, but the full projected depth had not been obtained throughout. At Winslows Island, about midway of the channel, and where it was shoalest, a depth of about 2 feet at mean low tide had been secured by the removal of bowlders.

Removal of rocks and bowlders at Winslows Island, under contract with Townsend & Olsen, was commenced June 15, 1900, but progress was very slow and by the close of the fiscal year only 83 tons had been removed.

The improvement when completed will be fairly permanent except that a gradual washing into the dredged channel of soft mud from the flats on either side will cause some shoaling.

The small sailing vessels now landing at South Penobscot do not use the new channel on account of the ledges at Winslows Island, and can, therefore, go in or out at high water, drawing not more than about 8 feet. Vessels drawing 12 to 14 feet could pass in and out at high water should the improvement be completed.

The commerce for the last seven years is given as follows:

	Tons.		Tons.
1893	49,300	1897	86,600
1894	67,850	1898	79,965
1895	85,900	1899	89,500
1896	78,050		

Probably the greater part of this pertains to Castine, at the mouth of the river.

July 1, 1899, balance unexpended		$3,209.82
June 30, 1900, amount expended during fiscal year		129.45
July 1, 1900, balance unexpended		3,080.37
July 1, 1900, outstanding liabilities	$143.65	
July 1, 1900, amount covered by uncompleted contracts	2,800.00	
		2,943.65
July 1, 1900, balance available		136.72
Amount (estimated) required for completion of existing project		21,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix A 7.)

9. *Penobscot River, Maine.*—The improvement of the Penobscot River was first undertaken in 1870, the project being for a channel not less than 150 feet wide, 12 feet deep at low tide, as far up as Bangor. At that time the channel was shoal and dangerous. At Bangor the depth did not exceed about 6 feet at lowest stages, and navigation was obstructed by numerous rocks and ledges. The work was continued until 1880, and included also the removal of obstructions in the harbor at Bangor and at Bucksport, the expenditures aggregating $198,000. No further work was done until 1884, when a project was adopted for widening the channel at Bangor and for certain improvements in the river below, near Crosbys Narrows, at an estimated cost of $75,000. While this work was in progress a survey was made, under the river and harbor act of 1886, from Bangor to Bucksport Narrows, and a project was submitted for securing a 22-foot depth between Bucksport and Winterport at an estimated cost of $365,000, making the combined cost of the two projects $440,000. The act of September 19, 1890, appropriated $25,000 and provided for dredging near Stern's mill.

Another survey was ordered in the act of September 19, 1890, which was made, and the report published in the Annual Report of the Chief of Engineers for 1892 (pp. 533–540).

The existing project for the improvement of the Penobscot River may be stated as follows: To widen the channel at Bangor to 360 feet and a depth of 11 feet at extreme low tide; to widen, straighten, and deepen the channel near Crosbys Narrows and near Stern's mill to a depth of 12 feet at extreme low tide, and to secure a channel depth of 22 feet at mean low tide between Bucksport and Winterport, the estimated cost of the entire work being $440,000. This estimate includes the cost of jetties at Frankfort Flats and High Head, in order to contract the waterway should contraction be necessary. It is thought, however, that as the deposit of sawdust and mill waste into the river has in a large measure been stopped, and as the channels at these places were obstructed chiefly by this material, the contraction works may not be necessary. The channel at Frankfort Flats was dredged in 1890 to 22 feet Subsequently it filled up on the sides to some extent, the full depth in mid-channel being maintained. A later survey showed that it had scoured out again, and that there existed a navigable channel not less than 500 feet wide and 22 feet or more in depth at low tide. As this is all the project contemplates, no further works of any kind are now proposed at Frankfort Flats.

The channel at High Head, which had deepened in 1891 from natural causes, subsequently filled up to some extent, so that it became advisable to dredge a channel the full depth and width called for by the project. This was done during the season of 1894.

An examination at both Frankfort Flats and High Head late in the season of 1896 showed that at Frankfort Flats there was a good channel not less than 300 feet wide, with a depth of not less than 22 feet at mean low tide. At High Head there was a break in the 22-foot contour for a distance of 500 feet. On the crest of this shoal the least depth was in excess of 19 feet at mean low tide.

The appropriations up to the close of the fiscal year ending June 30, 1899, aggregated $376,300, and the expenditures under the various projects (including original survey) to the same date amounted to $339,322.36. The results accomplished are the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide to 11 feet, for a width of 360 feet; the dredging of a shoal at Stern's mill to 12 feet, and of a shoal just below Stern's mill to the same depth; the removal of rocks, ledges, and other obstructions; the dredging of the shoals near Bucksport, and a general increase in depth and width of channel from the mouth up to Bangor.

The available depths are as follows: At Bangor Harbor 14 feet at mean low tide (which is about 3 feet above extreme low tide); at Stern's mill and Crosbys Narrows, 15 feet at mean low tide; at Frankfort Flats and at High Head above Bucksport, 22 feet at mean low tide. At the latter locality the channel varies from time to time owing to the shifting character of the material. No appropriation is asked for further work under the existing general project, as the aim of the project is already practically accomplished and the sum available is held to meet emergencies until permanent conditions are assured.

By act of March 3, 1899, Congress appropriated $28,000 for completing an improvement of the Penobscot River at Bangor, in accordance with project submitted May 3, 1897. The detailed plan of improvement under the project of May 3, 1897, as approved by the Secretary of War May 18, 1899, contemplates dredging at the mouth of the Kenduskeag Stream and through both draws of the railroad bridge, and within the basin between the latter bridge and the Post-office bridge, so as to obtain a uniform depth of 1 foot above level of extreme low water to within 30 feet of the wharves. The same project also provides for deepening the harbor of Bangor in front of the Boston and Bangor Steamboat wharf by the excavation of ledge to a depth of 11 feet at extreme low tide. A contract has been entered into for the work at both points at $7.65 per cubic yard for ledge excavation and 28.7 cents per cubic yard for dredging. Work was commenced at both places June 22, 1900. Up to the close of the fiscal year 1,986 cubic yards of material had been dredged from the Kenduskeag, and a small portion of the ledge had been blasted. It is believed that the contract will be completed before the end of the fiscal year ending June 30, 1901.

Preliminary examinations of Bucksport Harbor and of Penobscot River at and near Bucksport Narrows, authorized by the river and harbor act of March 3, 1899, were made during the year and the reports published as House Docs. Nos. 275 and 61, respectively, Fifty-sixth Congress, first session. They are also printed herewith as Appendixes A 16 and A 15, respectively.

The condition of the river in the vicinity of Stern's mill, below Bangor, has not perceptibly changed since the completion of improvements made in 1892; the river has deepened in many places, and for purposes of general navigation the river channel is adequate.

The commerce of the river for the last seven years is given as follows:

	Tons.		Tons.
1893	565,887	1897	790,698
1894	750,313	1898	639,671
1895	617,859	1899	658,632
1896	715,911		

July 1, 1899, balance unexpended		$36,977.64
June 30, 1900, amount expended during fiscal year		611.77
July 1, 1900, balance unexpended		36,365.87
July 1, 1900, outstanding liabilities	$62.50	
July 1, 1900, amount covered by uncompleted contracts	25,248.75	
		25,311.25
July 1, 1900, balance available		11,054.62

(See Appendix A 8.)

10. Rockland Harbor, Maine.—The first improvement at this point was made to render it a safe harbor of refuge for coastwise shipping during easterly storms. During such storms the harbor afforded no protection, the anchorage was unsafe, and the waves frequently broke over the wharves.

The original project for obtaining the required shelter provided for two breakwaters and was adopted in 1881. As an experiment, and with a view to economy, their height was tentatively placed at only 5 feet above mean low water or 5 feet below mean high water, the average rise and fall of tide at this point being about 10 feet. The estimated cost was $550,000.

In 1886 the project was amended so as to raise the height to the level of mean high tide, at an estimated cost of $650,000.

In 1890 the project was again modified so as to provide for a further extension southward of the breakwater at Jamesons Point than was contemplated in the original plan, and eliminate from the project the construction of the second breakwater, not yet commenced, whose construction was rendered unnecessary by the extension of the first or outer breakwater.

By the act of June 3, 1896, this work was combined with that for dredging the harbor and both as one whole placed under the continuous-contract system.

During the winter of 1899–1900 the breakwater was exposed to two storms of considerable violence, on each occasion the tide rising to a height estimated at from 3 to 4 feet above mean high water. The amount of wave action coming into the harbor over the top of the breakwater, joined to that coming around the end, produced a dangerous agitation of the water in the vicinity of the wharves for a period of about two hours when the tide was highest. The effect of these two storms suggested the necessity for a further increase in the height of the breakwater, so as to make the wharves reasonably safe at all stages of the tide, and the project was again modified so as to raise the structure to a height of about 4 feet above mean high water, or an average of about 4 feet above the level of the present top of the breakwater. As the stones in the present top of the breakwater are only about 2 tons in weight, and as some of these were displaced by wave action during these storms, it is proposed to utilize stones of 6 tons weight or more in the capping now authorized. Provision has also been made for raising the shore end of the breakwater, where the height was below the general level, and for extending the breakwater to full height and section to the shore. This work was begun on June 28, 1900, under contract with Romano V. Perini, dated June 2, 1900.

At the beginning of the fiscal year work was in progress extending the breakwater, under contract with Charles H. Souther. The breakwater had been built to a point about 3,928 feet from the shore, and for a further distance of 143 feet a part of the stone had been deposited, and the expenditures had been $443,678.55. This work was completed to a length of 4,140 feet November 24, 1899, 100,455 tons of stone having been placed in it during the fiscal year, making a total of 415,087 tons under the contract.

By the act of June 3, 1896, Congress adopted a project for dredging the inner harbor in the vicinity of the wharves to depths ranging from 4 feet to 13 feet at mean low tide, so as to accommodate vessels of deeper draft than had been used in the commerce of this port. The same project provided for the removal of two dangerous groups of ledge occupying central positions in the harbor and interfering with navigation and with the use of the protected area as an anchorage. Included in the project was an item for the removal of a sunken wreck. The estimated cost of this improvement was $402,000.

By the same act Congress combined the latter project with the project for the breakwater as one, and authorized the work placed under the continuous-contract system, the combined estimated cost for the two being $1,036,000. The item in the act referred to is as follows:

> Improving harbor at Rockland, Maine: Continuing improvement, including project recommended by Chief of Engineers under date of December fourteenth, eighteen hundred and ninety-five, twenty-five thousand five hundred dollars, of which one thousand five hundred dollars may be expended for the removal of an old hulk sunk in the harbor: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of said projects for the improvement of said harbor, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and sixty thousand five hundred dollars, exclusive of the amount herein and heretofore appropriated.

At the beginning of the fiscal year dredging, under contract with Moore & Wright, was in progress, 188,271 cubic yards having been removed up to that time. Dredging was continued to November 14, 1899, but suspended on that date on account of ledge being encountered above grade and was not resumed till June 27, 1900. The total amount dredged during the fiscal year was 134,569 cubic yards. The total amount dredged to June 30, 1900, from the beginning of the contract was 322,840 cubic yards.

Owing to the discovery of ledge slight changes of the established harbor lines became necessary at Crocketts Point and at the head of the north cove. Also, upon petition of parties interested in the commerce of the harbor, another slight change was deemed advisable from Perry Brothers' wharf to and a short distance beyond Bird's wharf. These changes in the established harbor lines were approved by the Secretary of War May 17, 1900.

Ledge excavation was continued under contract with Dunbar & Sullivan, 12,702 cubic yards measured in place being removed from ledges D and E, and 1,900 cubic yards from ledge B during the fiscal year. A large part of ledge D has been drilled and blasted, but very little of the broken rock has been taken up.

An old wreck in the northern part of the harbor (the one referred to in the act of 1896) was removed.

The benefits resulting from these improvements are considerable. The construction of the breakwater will afford a safe and extensive anchorage and harbor of refuge, the excavation of ledges will increase the available anchorage area and remove dangerous obstructions to boats in motion, and the dredging will afford access to vessels of greater draft to the wharves when built out to the harbor line.

No additional funds are asked for, as it is believed that the funds already provided will, at existing contract prices, be sufficient to complete the improvement.

The commerce of Rockland Harbor for the last seven years is given as follows:

	Tons.		Tons.
1893	538,506	1897	594,992
1894	509,853	1898	579,300
1895	615,830	1899	755,649
1896	580,295		

July 1, 1899, balance unexpended		$481,821.45
June 30, 1900, amount expended during fiscal year		189,352.47
July 1, 1900, balance unexpended		292,468.98
July 1, 1900, outstanding liabilities	$12,804.98	
July 1, 1900, amount covered by uncompleted contracts	187,949.14	
		200,754.12
July 1, 1900, balance available		91,714.86

(See Appendix A 9.)

11. *Carvers Harbor, Vinalhaven, Me.*—The anchorage at this harbor was limited and the harbor shoal, there being less than 8 feet at mean low tide over the most of it.

The approved project is to dredge the inner harbor to a depth of 16 feet at mean low tide over an area about 23 acres in extent, and at an estimated cost of $64,000. The survey and estimate were made in accordance with the provisions of river and harbor act of 1894.

The expenditures to June 30, 1899, were $9,670.95. At that date an area at the lower end of the inner harbor 680 feet wide, with an average length of about 600 feet, had been dredged to the required depth of 16 feet at mean low tide.

Dredging under contract with Augustus R. Wright was begun April 10, 1900, and completed May 26, during which time 97,014 cubic yards of material was removed. This completed about 14 acres of the proposed area of 23 acres to be dredged as a harbor of refuge, and about 50 per cent of the amount of material to be removed therefrom.

Ledge was discovered about 3 feet above the required depth near the upper end and on both sides of the area dredged under this contract. A rock with its top only 7½ feet below mean low tide was discovered near the upper corner of the steamboat wharf while dredging was in progress under the previous contract.

It is proposed to make an examination to ascertain more definitely the character of the material remaining to be removed, and the extent of the underlying ledge.

The improvement, it is believed, will be fairly permanent, and will be of benefit to navigation in affording a harbor of refuge and increased facilities for reaching the wharves.

The commerce for 1896 is given as 63,078 tons; for 1897 as 63,074 tons; for 1898 as 60,000 tons; and for 1899 as 63,390 tons.

July 1, 1899, balance unexpended	$15,329.05
June 30, 1900, amount expended during fiscal year	14,540.19
July 1, 1900, balance unexpended	788.86
July 1, 1900, outstanding liabilities	5.00
July 1, 1900, balance available	783.86
Amount (estimated) required for completion of existing project	39,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	39,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 10.)

12. Georges River, Maine.—This river is a tidal estuary, and the head of navigation is Thomaston, Me. The navigable depth is full 3½ fathoms to a point about 1 mile from Thomaston, but from this point to the head of navigation the channel before improvement, as it wound through the flats, was narrow, with a sharp bend at one point and with a least depth of about 11 feet at mean low tide.

By act of June 3, 1896, Congress adopted a project for dredging the channel to 16 feet at mean low tide, and to a width of 160 feet as far up as the bend, to 220 feet in the bend, and to widths of 125 and 90 feet in front of the town.

The expenditures to June 30, 1899, were $9,728.62. At that date the channel had been dredged to the full projected width and depth for a distance of about 2,000 feet upstream from the 16-foot contour.

Under contract with Hamilton & Sawyer, dredging was begun July 21, 1899, and completed October 21, 1899. During this time 56,997 cubic yards of material, measured in scows, was removed, completing to the required depth of 16 feet, and to full width, a channel length of about 1,650 feet, and making the total length of channel now completed about 3,600 feet. There remains to be dredged a strip of channel about 90 feet wide and 900 feet long, requiring the removal of about 16,000 cubic yards of material in scows. This, with the repair of the stone beacon, will complete the entire project.

Owing to the small amount of material remaining to be dredged, it is probable that the price per cubic yard will be relatively large, and is estimated at 30 cents. As the stone beacon is in a much more dilapidated condition than at the time the survey was made, its repair will cost more than then estimated.

The revised estimate for the completion of the approved project is, therefore, given as follows:

Dredging 16,000 cubic yards of material, in scows, at 30 cents	$4,800
Repairing stone beacon	400
Contingencies, engineering, etc	800
Total	6,000

This is $4,000 less than the amount required to complete the project according to the original estimate, but, being regarded as sufficient for the purpose, is all that is asked for at the present time.

Material brought down by the river during freshets will doubtless cause shoaling in the channel, but the process will be slow, and a depth sufficient to accommodate the traffic will probably be maintained for a number of years.

The depth of the dredged channel is such that the vessels using it could be towed out at any stage of tide, but as the business does not seem to warrant the maintenance of a tug boat, they have to wait until near high water and a favorable wind in order to go out or in under sail with safety.

The commerce for the last four years is given as follows: For 1896, 45,375 tons; for 1897, as 64,250 tons; for 1898, as 59,000 tons; and for 1899, as 60,000 tons.

July 1, 1899, balance unexpended	$10,271.38
June 30, 1900, amount expended during fiscal year	10,058.76
July 1, 1900, balance unexpended	212.62
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 11.)

13. Kennebec River, Maine.—Before the improvements were commenced the main channel of the river between the foot of Swan Island and Gardiner was obstructed by shoals near Beef Rock, with only 10 feet of water at mean low tide; by dangerous sunken ledges in Lovejoy Narrows; by a shoal below South Gardiner with only 8 feet on it at mean low tide, and by a ledge at Nehumkeg Island. The steamboat channel to the west of Swan Island (at Hatchs Rock) was obstructed by a shoal over which there was only 7½ feet of water, and the channel between Gardiner and Augusta, a distance of 6½ miles, was obstructed by shoals which gave a navigable depth of only 3½ feet of water in low summer tide.

Appropriations were made at various times between 1827 and 1852 for improving the river, and a project was adopted in 1866 for removing rocks and straightening and deepening the upper part of the river. The estimated cost was $50,000.

In 1868 the project was amended so as to give a wider channel, and the estimate was increased to $80,000. In 1871 the project was extended, the additional cost being estimated at $13,000, making the estimate for the entire project $93,000. It was again extended in 1872 to include the removal of ledges in Lovejoy Narrows at an additional estimated cost of $30,603.61. This project was modified in 1873, and as modified was completed in 1877.

In 1881 a project was adopted for the improvement of the channel west of Swan Island and near the north end of it. The estimated cost of this project, which was completed in 1883, was $20,500.

The river and harbor act of 1886 provided for a new survey of the river from Bath to Augusta. This survey was made in 1887, and a project submitted for a further improvement of the river, giving 12 feet clear depth at low tide up to the Upper Sands Bar, near South Gardiner, 10 feet thence to Hinckley Shoal, and 8 feet thence to Augusta, together with an improvement of the steamboat channel west of Swan Island to 9 feet at mean low tide. The estimated cost of this project was $410,500, which estimate was subsequently increased to $428,500.

In August, 1892, the project was revised and a general project for the improvement adopted, as follows: For a channel depth of 13 feet up as far as Sands Island; 12 feet thence to Hinckley Shoal, and 10 feet thence to Augusta; a steamboat channel 9 feet deep west of Swan Island, and the removal of old bridge piers at Hallowell, all the above depths being referred to mean low tide. The estimated cost of this revised project, which was approved August 19, 1892, was $388,500.

The total expenditures for the river up to June 30, 1899, amounted to $471,504.20. The following work had been accomplished:

The channel near Beef Rock had been improved to give a clear depth of over 12 feet, and a training wall completed. The dangerous rocks in Lovejoy Narrows had been removed to a depth of 15 feet and the channel straightened. Channels had been dredged to 12 feet at mean low tide through Upper Sands Bar, Gardiner Shoal, Browns Island Shoal, and Hinckley Lower Shoal, and to 10 feet through Hinckley Upper Shoal, Britts Shoal, and Gages Shoal to Augusta. The ledge at Nehumkeg Island had been removed to 12 feet. The steamboat channel west of Swan Island had been deepened to 11 feet, and the old piers of the bridge at Hallowell had been removed. A jetty about 1,500 feet long had been completed at Upper Sands Bar. In other words, all the work under the existing project had been completed, with exception of the repair of Beef Rock Jetty and possibly some dredging at that locality.

The only operations during the fiscal year 1900 consisted in making an examination and survey of the river between Gardiner Bridge and Augusta Dam, as ordered by the river and harbor act of March 3, 1899. The report on this survey was forwarded December 19, 1899, and is printed in House Doc. No. 262, Fifty-sixth Congress, first session, and is herewith as Appendix A 20. The project therein contained has not yet been acted upon by Congress.

The dredged channel, especially between Gardiner and Augusta, has been found to fill more or less rapidly, probably with material brought down during heavy spring freshets. The parts of the improvement consisting of the removal of ledge are, of course, permanent. Vessels drawing 14 to 16 feet can get up as far as Gardiner at high tide, but only 11 or 12 feet can be carried to Augusta.

No further appropriation is now asked for, as, unless new conditions develop, the funds already appropriated are sufficient for completion of the existing project.

The commerce of the river is given as follows:

	Tons.		Tons.
1892	1,263,145	1897	665,991
1893	970,938	1898	1,211,808
1894	1,207,965	1899	714,199
1895	1,162,972		

July 1, 1899, balance unexpended	$28,845.80
June 30, 1900, amount expended during fiscal year	1,156.59
July 1, 1900, balance unexpended	27,689.21

(See Appendix A 12.)

14. Portland Harbor, Maine.—The entrance to the main part of the harbor of Portland, or the anchorage, has always been good, but prior to the improvements made by the Government the approach to the inner harbor was obstructed by a shoal known as the middle ground, over which the depth was only from 8 to 10 feet at mean low tide, while between it and Stamford Ledge the greatest available depth was only 16 feet. Besides, the best part of the wharf front of the city was exposed to the swell from the Atlantic, which sometimes made it dangerous for vessels to lie at the docks, and the depth along this front was in some places as little as 4 feet, making a part of it unavailable for commercial purposes.

The first work of improvement undertaken by the Government was the construction of the breakwater. This was begun as early as 1836. It was completed in 1874.

The project for the improvement of the harbor by deepening its waters was first undertaken by authority of act of Congress of 1868. The project at that time was to excavate a channel 300 feet wide through the southern slope of the middle ground to a depth of 20 feet at mean low tide and the removal of the bar off the Grand Trunk wharves to the same depth.

In 1870 the project was amended so as to provide for a channel 400 feet wide, and in 1871 it was again amended so as to provide for a width of 500 feet.

In 1872 the improvement of Back Cove was added to the project, and in December of that year the project was further amended by providing for the dredging of the inner harbor up to the harbor commissioners' lines to a depth of 16 feet. By 1876 all the contemplated improvements had been executed except some dredging in the inner harbor.

In 1881 Congress made an appropriation for the further improvement of the harbor, and a project was adopted looking to the entire removal of the shoal known as the middle ground, at an estimated cost of $160,000. The project was completed in 1885.

In 1886 a project was adopted for the further deepening of a portion of the harbor to 29 feet at mean low tide at an estimated cost of $135,000, and in 1890 this project was extended to include a small quantity of dredging in the upper part of the harbor at an estimated cost of $5,000. In 1894 it was again extended to cover the widening of the upper portion of the 29-foot area and the dredging of a channel 25 feet deep to connect the deep water in the lower part of the harbor with that in the upper part. This work was completed in 1894.

By the act of June 3, 1896, Congress adopted a project for dredging to 30 feet at mean low tide over the greater part of the harbor at an estimated cost of $770,000. By the same act the partly completed project for improving Back Cove was combined with that of the main harbor, the combined estimate being $946,250. The same act appropriated $20,000 for beginning the work and authorized the making of contracts for its completion, but limited such contracts to $810,000,* in addition to the amount appropriated. The language of the act is as follows:

> Improving Portland Harbor, Maine, according to the report of the Chief of Engineers dated April seventeenth, eighteen hundred and ninety-six, and continuing improvement of Back Cove, according to existing project, twenty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such projects, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and ten thousand dollars, exclusive of the amount herein appropriated.

After twice advertising, a contract for the entire work was entered into with George M. Valentine & Co., of New York, at 20 cents per cubic yard for dredging over the 29-foot area, and 9.98 cents for the remainder. Dredging was commenced July 2, 1897, and by the terms of the contract was to be completed November 30, 1898.

From the beginning the plant was inadequate, management feeble, and progress slow and unsatisfactory. For the first fifteen months the average monthly progress was only 18.3 per cent of that required by the contract. Toward the close of this period a larger dredge was placed on the work, and under the promise of better progress in the future, the contract was extended to November 30, 1899. Work continued at a more satisfactory rate during the winter of 1898–99, but was brought to a standstill by the seizure of the contractors' plant on April 19, 1899, for debt, and its subsequent sale under decree of the United States district court.

The collapse of the firm financially and otherwise was complete, and no serious effort was thereafter made to resume work during the life of the contract.

As soon as it became evident that George M. Valentine & Co. would probably not resume dredging, an arrangement was entered into with Mr. A. R. Wright, of Portland, Me., for placing dredges on the work and continuing dredging to the end of the contract period (November 30, 1899), the price paid being 10½ cents per cubic yard, scow measurement, for areas not previously partly dredged, and 20 cents per cubic yard, scow measurement, for areas previously partly dredged.

At the beginning of the fiscal year dredging by George M. Valentine & Co. was in suspension and that under the arrangement with Mr. A. R. Wright was in progress. Mr. Wright's dredges continued work till the contract expired on November 30, 1899, since which date no dredging has been done.

The time for completing this contract with George M. Valentine & Co., as extended, having expired by limitation on November 30, 1899, proposals were invited by public advertisement and opened March 27, 1900. The lowest bid received was 17½ cents per cubic yard for all but the 29-foot area; was deemed too high and was rejected. Proposals were again invited and opened June 30, 1900. The lowest bid received under the second advertisement was 16½ cents per cubic yard for dredging the 29-foot area and 13.85 cents per cubic yard for the remainder, by the Morris & Cumings Dredging Company, of New York. This bid has been accepted.

The total amount removed by George M. Valentine & Co. from the beginning of their contract until their collapse on April 19, 1899, was 1,469,713 cubic yards, situ measurement, at 9.98 cents, and 1,833 cubic yards dredged in the 29-foot channel, at 20 cents per cubic yard. The total removed under the arrangement with Mr. A. R. Wright was 316,626 cubic yards, scow measurement, at 10½ cents per cubic yard, and 112,743 cubic yards, scow measurement, at 20 cents per cubic yard.

In removing the above quantities the following areas have been dredged to 30 feet at mean low tide: In front of Galt, Franklin, and Maine wharves, an area about 450 feet wide and 650 long; widening main entrance 180 feet by 1,800 feet, making that channel about 680 feet wide; large area opposite Grand Trunk wharves, 1,100 feet wide by 2,100 feet long, and an additional area about 600 feet wide and 2,200 feet long in the upper part of the harbor.

The total amount expended on Portland Harbor, including Back Cove, up to June 30, 1900, is $903,209.64.

In round numbers, the estimated quantities to be dredged to complete the project include about 2,420,000 cubic yards measured in situ of general dredging, and 93,000 cubic yards from the area formerly dredged to 29 feet at mean low water, and the estimated cost thereof under the contract to be made with the Morris & Cumings Dredging Company is $350,515. Adding to the above the sum of $30,000 for engineering and contingencies, the total amount required to complete the project is $380,515, or, in round numbers, $380,000.

The commerce of Portland Harbor for the past seven years is given as follows:

	Tons.		Tons.
1893	1,432,805	1897	1,326,844
1894	1,214,887	1898	1,334,752
1895	1,339,064	1899	1,620,284
1896	1,357,575		

July 1, 1899, balance unexpended	$422,659.76
June 30, 1900, amount expended during fiscal year	63,142.35
July 1, 1900, balance unexpended	359,517.41
July 1, 1900, outstanding liabilities	331.74
July 1, 1900, balance available	359,185.67
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	21,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 13.)

15. Removing sunken vessels or craft obstructing or endangering navigation.—(*a*) The wreck of the schooner *Lavinia Bell*, Kennebec River, at Bath, Me., proposals for the removal of which had been invited at the close of the last fiscal year, was removed, under contract, during August, 1899. The total cost was $555.60.

(*b*) The wreck of a small scow or schooner known as *Old Swan*, Marsh River, Frankfort, Waldo County, Me., was removed during May and June, 1900. The contract price was $240.

(*c*) The wreck of the small schooner *Vicksburg*, Seal Harbor, Maine, was removed, under contract, during May, 1900. The contract price was $325.

(See Appendix A 14.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. S. W. Roessler, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. G. L. Gillespie, Corps of Engineers:

1. *Examination of Penobscot River, Maine, at and near Bucksport Narrows.*—Major Roessler submitted report dated August 3, 1899. He stated that the depth of water at this point is very great and that the only place in the vicinity requiring improvement is Bucksport Harbor, respecting which a separate examination was provided for in the act and report thereon submitted. The report is printed in House Doc. No. 61, Fifty-sixth Congress, first session. (See also Appendix A 15.)

2. *Examination and survey of Bucksport Harbor, Maine.*—Major Roessler submitted reports dated August 2 and December 16, 1899, respectively. Two plans for improvement are presented, estimated to cost, for a 14-foot depth $12,500, and for a 16-foot depth $20,000, the latter plan being preferred. The reports were transmitted to Congress and printed in House Doc. No. 275, Fifty-sixth Congress, first session. (See also Appendix A 16.)

3. *Examination of mouth of Kenduskeag River, Maine, with a view to securing a channel 2 feet deep at extreme low tide for the entire width of the river.*—Major Roessler submitted report dated May 6, 1899. In his opinion the locality is not worthy of improvement to the extent indicated, at the present time, and his views are concurred in by the Division Engineer, Col. G. L. Gillespie, Corps of Engineers, and by me. The report was transmitted to Congress and printed in House Doc. No. 54, Fifty-sixth Congress, first session. (See also Appendix A 17.)

4. *Examination and survey of Camden Harbor, Maine.*—Major Roessler submitted reports dated June 15 and December 23, 1899, respectively. He presents a plan for improvement by dredging to a depth of 14 feet at mean low water in front of the Boston and Bangor Steamship Company's wharf, at an estimated cost of $7,400; but in his opinion the inner harbor is not worthy of further improvement at the present time. The views of Major Roessler are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 263, Fifty-sixth Congress, first session. (See also Appendix A 18.)

5. *Examination and survey of Boothbay Harbor, Maine.*—Major Roessler submitted reports dated August 18 and December 20, 1899, respectively. From the facts developed during the survey, the local officer concludes that the locality is so well favored by natural advantages that no artificial works of improvement in the interests of navigation are required at the present time, and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 277, Fifty-sixth Congress, first session. (See also Appendix A 19.)

6. *Examination and survey of Kennebec River, Maine, between Gardiner and Augusta.*—Major Roessler submitted reports dated August 25 and December 19, 1899, respectively, and a plan of improvement at an estimated cost of $81,000 is presented. The reports were transmitted to Congress and printed in House Doc. No. 262, Fifty-sixth Congress, first session. (See also Appendix A 20.)

7. *Examination and survey of Parkers Head Harbor and Channel, Kennebec River, Maine.*—Major Roessler submitted reports dated August 14 and December 21, 1899, respectively, and presented a plan for improvement at an estimated cost of $20,000; but from information obtained in connection with the survey, he concludes that the locality is not worthy of improvement by the General Government at the present time. His views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 276, Fifty-sixth Congress, first session. (See also Appendix A 21.)

EXAMINATION OF PORTLAND HARBOR, MAINE, AT WITCH ROCK, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Portland Harbor, Maine, with a view to removing so much of Witch Rock as endangers navigation*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE SOUTH OF PORTLAND HARBOR, IN NEW HAMPSHIRE, AND IN MASSACHUSETTS NORTH OF LYNN HARBOR.

This district was in the charge of Maj. W. L. Fisk, Corps of Engineers, having under his immediate orders Lieut. (now Capt.) Charles Keller, Corps of Engineers, from September 30, 1899, to November 15, 1899. Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

1. *Saco River, Maine.*—[This work was in the charge of Maj. S. W. Roessler, Corps of Engineers, until September 30, 1899.] The first work done on the Saco River was in 1827, when an appropriation was made for the erection of piers, placing beacons or buoys, and removing obstructions. Prior to this the depth of water on the bar was only about 2 feet at mean low tide, while much of the river was deeper. The entrance was also dangerous in rough weather, and the numerous projecting rocks and ledges in the river proper, in connection with the swift currents, made its navigation dangerous.

In 1866 a plan was proposed for the improvement of the mouth of the river and a project was adopted in 1867. The project was for the construction of a breakwater, the removal of sunken rocks, and the rebuilding of some of the most important piers, against which vessels might drift without damage. This project was completed in 1878 at a cost of $169,275.

A resurvey of the breakwater was made in 1883 and a new plan submitted for raising and repairing it and extending it out to Sharps Ledge.

The river and harbor act of 1884 directed a survey to be made of the river. This was done in 1885, and a plan submitted for the improvement of the river proper from its mouth to the head of navigation. In 1890 the two projects were combined so that the one now in process of execution is for improving the Saco River, including the breakwater and jetty.

The total expenditures on both river and breakwater up to June 30, 1899, amounted to $338,436.43, and resulted in removing dangerous ledges, in constructing piers to prevent vessels from being swept on the rocks, in constructing a breakwater on the north side of the entrance, and a jetty on the south side of the entrance to contract the channel way with a view to obtaining a greater depth over the bar; also, in deepening the channels in the upper portion of the river by dredging, and the construction of contraction works.

A recent examination shows that at the present time about 3½ feet at mean low water is the maximum draft that can be carried over the bar just outside the breakwater and jetty.

In order to maintain the desired depth the breakwater on the north side should be extended to Sharps Ledge, as contemplated by the plan of improvement submitted in 1883, in order to stop the influx of sand from that side. Some uncertainty exists whether Congress has adopted the plan of extending the breakwater to Sharps Ledge. The probable cost of such extension and some minor repairs is estimated by the officer in local charge to be $200,000. Possibly the full extension may not be required to secure and maintain the projected depth.

Minor operations were in progress at the close of the fiscal year and consisted in repairing the south jetty in several low places and in constructing a beacon at its outer end.

The commerce of the last seven years is given as follows:

	Tons.		Tons.
1893	59,765	1897	42,214
1894	47,350	1898	44,508
1895	62,125	1899	46,597
1896	46,956		

July 1, 1899, balance unexpended		$8,338.57
June 30, 1900, amount expended during fiscal year		160.99
July 1, 1900, balance unexpended		8,177.58
July 1, 1900, outstanding liabilities	$1,414.84	
July 1, 1900, amount covered by uncompleted contracts	813.91	
		2,228.75
July 1, 1900, balance available		5,948.83
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix B 1.)

2. *Cape Porpoise Harbor, Maine.*—[This work was in the charge of Maj. S. W. Roessler, Corps of Engineers, until September 30, 1899.] This is a new work. The harbor at Cape Porpoise is situated about midway between Portland, Me., and Portsmouth, N. H. Originally the harbor had a depth of about 13 feet at mean low tide, but for a small area only, and the entrance was obstructed by a bar on which there was only about 10 feet of water at mean low tide. The anchorage was too small to accommodate the small vessels seeking that place for refuge, without regard to the commerce of the place.

By act of March 3, 1899, Congress adopted a project for securing a channel of entrance 200 feet wide and 16 feet deep at mean low tide and a channel and anchorage within the harbor about 3,000 feet long, 600 feet wide, and 15 feet deep at mean low tide, at an estimated cost of $125,000. By this act the improvement was placed under the continuous-contract system and $70,000 appropriated toward the work. The project is described in the Annual Report of the Chief of Engineers for 1899, page 1050.

There were no expenditures up to June 30, 1899.

Contract for the entire work at 9.2 cents per cubic yard has been entered into and operations thereunder were commenced early in June, 1900. The contract price is so much below the original estimate that it is thought the total amount required for the entire work will be reduced to $80,000, all of which has been appropriated.

On June 30, 1900, about one-half the length of the entrance channel had been completed to full projected width and depth, and about 10,000 square feet of the anchorage basin had been dredged to the required depth, except over a small area where ledge was found.

There is only about 10 feet at mean low water over the part of the entrance to the harbor that has not been dredged.

It has been impracticable to obtain detailed commercial statistics since 1898, when an aggregate of 20,350 tons of coal and fish was reported.

July 1, 1899, balance unexpended		$70,000.00
Amount appropriated by sundry civil act approved June 6, 1900		10,000.00
		80,000.00
June 30, 1900, amount expended during fiscal year		505.46
July 1, 1900, balance unexpended		79,494.54
July 1, 1900, outstanding liabilities	$4,421.03	
July 1, 1900, amount covered by uncompleted contracts	61,743.22	
		66,164.25
July 1, 1900, balance available		13,330.29

(See Appendix B 2.)

3. Cocheco River, New Hampshire.—[This work was in the charge of Maj. S. W. Roessler, Corps of Engineers, until September 30, 1899.] Before the improvement was begun, the river from Dover to the Lower Narrows was much obstructed by bowlders, ledges, and shoals, the depth being in some places as little as 6 inches at mean low tide. The tide rises and falls about 7 feet.

A project for improvement was adopted in 1871, which provided for a channel 40 feet wide and 4 feet deep from the Lower Narrows up to Collin's wharf. The estimated cost was $45,000. Subsequently more accurate and extended surveys having shown the practicability and importance of extending the improvements up to the head of navigation, the project was extended and the estimate increased to $85,000. This project was completed in 1879. The improvements had opened up a large commerce, employing large vessels where formerly only flatboats had been used, in consequence of which the project was still further extended by providing for a "cut-off" through Alleys Point, widening to 60 feet and deepening to 5 feet the existing channels through Trickeys and Clements Point shoals, and blasting and removing other obstructions. The extended project was completed in 1888.

In 1889 a new survey was made, under the river and harbor act of 1888, and a new project was submitted for obtaining a depth of 7 feet, increased to 7½ feet in rock, with a width of 50 feet in rock and 60 to 75 feet where the material is less expensive to remove. This project was adopted in 1890 and is estimated to cost $175,000.

The total expenditures for this river up to June 30, 1899, amounted to $234,844.54. These expenditures resulted in giving a channel through the rocky bed of the river 5 feet deep and 40 feet wide in the narrowest parts, where the depth before was only from 6 inches to 2 feet. Under the last project the upper end of the channel at Dover had been deepened to 7 feet at mean low tide for a length of 1,200 feet, with a width varying from 100 to 140 feet. Portions of the channel above and below Clement's wharf, of a total length of 600 feet, had also been dredged to the same depth, and the excavation of the channel through ledge at Upper Narrows and Lower Narrows to 7½ feet at mean low tide had been completed.

Operations during the fiscal year 1900 began at Clement's wharf, where the last dredging terminated, and consisted in deepening the channel, continuing the dredging down river a distance of 2,200 feet, making a total length of channel at the upper end of 3,400 feet completed to full proposed dimensions, except over a small portion in the lower part, where, owing to ledge, the required depth was not made.

The available depth is but 5 feet at mean low tide.

The commerce for the last seven years is given as follows:

	Tons.		Tons.
1893	66,933	1897	[1]
1894	68,415	1898	131,005
1895	83,151	1899	144,040
1896	59,755		

July 1, 1899, balance unexpended	$25,155.46
June 30, 1900, amount expended during fiscal year	19,079.94
July 1, 1900, balance unexpended	6,075.52
Amount (estimated) required for completion of existing project	85,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 3.)

4. *Exeter River, New Hampshire.*—[This work was in the charge of Maj. S. W. Roessler, Corps of Engineers, until September 30, 1899.] A survey of this river was made in 1874, from its mouth in Great Bay up to the wharves at Exeter, a distance of 8.3 miles, and a project was submitted to obtain a towing channel with a minimum width of 40 feet and a minimum depth from the mouth to Oxbow (5.6 miles) of 12 feet at high tide, and from Oxbow up to Exeter of 10 feet, and to remove the bowlders all the way up between the 10-foot contours down to a depth of 10 feet below high tide, at an estimated cost of $34,000. This improvement was completed in 1882 at a cost of $35,000.

Under the requirements of the river and harbor act of June 3, 1896, a new survey was made from the mouth of the river to the upper bridge at Exeter, N. H., and a report (printed in Annual Report of the Chief of Engineers for 1897, p. 818) submitted, containing a project for a towing channel 40 feet wide, 12 feet deep at mean high tide up to Oxbow, and 11 feet deep at mean high tide thence up to Exeter, the estimate of cost being $12,000. By the act of March 3, 1899, this project was adopted, and the entire amount of the estimate appropriated.

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[1] No statement could be obtained.

The total expenditures for this work up to June 30, 1899, were $35,000. At that date the river was reported to have filled in somewhat since the completion of the former project in 1882, the maximum fill being about 1 foot.

Operations under the new project were begun in May, 1900, at the head of navigation in Exeter, and up to the close of the fiscal year the channel had been completed to the required width and depth for a distance of 800 feet down river.

As the work has progressed it is found that the actual amount of excavation required will exceed the original estimate, which will be insufficient to complete the project.

The available depth up to the wharves at Exeter does not exceed 3 feet at mean low tide, or about 9 feet at mean high tide.

The commerce on the river last year is given as 10,785 tons; there are no statistics on record prior to that except in 1896, when it was reported as 10,166 tons.

July 1, 1899, balance unexpended		$12,000.00
June 30, 1900, amount expended during fiscal year		1,248.79
July 1, 1900, balance unexpended		10,751.21
July 1, 1900, outstanding liabilities	$4,384.56	
July 1, 1900, amount covered by uncompleted contracts	5,960.44	
		10,345.00
July 1, 1900, balance available		406.21
Amount (estimated) required for completion of existing project		7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 4.)

5. *Harbor of refuge at Little Harbor, New Hampshire.*—[This work was in the charge of Maj. S. W. Roessler, Corps of Engineers, until September 30, 1899.] A survey was made of Little Harbor in 1882, and a plan of improvement proposed for the opening of a channel of entrance to a depth of 9 feet at low tide and a width of 100 feet, together with a basin 300 by 700 feet, which was to be protected by a rubblestone breakwater. The estimated cost was $33,000. This project was approved in 1886 and its execution entered upon. In 1887 the project was enlarged to provide for the construction of two breakwaters—one on the north, the other on the south side of the entrance to the harbor—and the dredging of an anchorage about 49 acres in extent in the protected area to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000, and the act of 1888 made an appropriation for the work on the enlarged plan.

In October, 1894, after the breakwaters had been completed and a part of the dredging accomplished, the project was amended by reducing the area of the anchorage to be dredged to about 40 acres instead of 49. At the same time the project was revised, and the cost of the entire work placed at $145,000.

Before the improvement the depth in the harbor was only about 6 feet at low tide, and the anchorage was small and exposed.

The expenditures up to June 30, 1899, amounted to $119,928.06. At that date both breakwaters had been completed and the anchorage had been dredged to a width of about 500 feet—9 feet deep at mean low tide for about 115 feet and 12 feet deep for the remaining width.

Operations were in progress during the past fiscal year under the appropriation of $12,000 made by the act of March 3, 1899, and on June 30, 1900, the anchorage area had been widened about 50 feet to the full depth.

The available depth is 12 feet at mean low tide over the greater part of the anchorage and the entrance, and 9 feet over the remainder of the anchorage.

There is no regular commerce, but during the calendar year 1899 the number of vessels seeking shelter was 150, besides many small fishing boats.

July 1, 1899, balance unexpended		$12,071.94
June 30, 1900, amount expended during fiscal year		706.37
July 1, 1900, balance unexpended		11,365.57
July 1, 1900, outstanding liabilities	$4,651.99	
July 1, 1900, amount covered by uncompleted contracts	6,157.11	
		10,809.10
July 1, 1900, balance available		556.47
Amount (estimated) required for completion of existing project		13,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		13,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix B 5.)

6. *Newburyport Harbor, Massachusetts.*—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Newburyport, Mass., is situated about 2½ miles from the Atlantic Ocean, on the south bank of the Merrimac River. The mouth of the river is obstructed by a sandy bar, over which originally but 7 feet draft at low water could be carried in a narrow, shifting channel.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubblestone jetties, their outer ends 1,000 feet apart and to be extended parallel to the axis of the channel, if necessary, and the protection of the beach in their vicinity, at a cost, as estimated in 1881, of $365,000. The direction of jetties and shore protection were modified in 1883, and in 1882 the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water was added to the project, increasing the cost to $375,000, as estimated in 1884.

In 1884 a modification of project provided for extension of both jetties parallel to the axis of the channel for a distance of 610 feet, and in 1886 the length of extension was increased to 1,000 feet, increasing the cost of work, as estimated in 1897, $224,547.49.

The total amount appropriated for this work to date is $338,500, $3,000 of which may, in the discretion of the Secretary of War, be expended in removing North Rock from the harbor.

The total expenditures to June 30, 1899, were $312,162.62. No work having been in progress during the fiscal year 1899, the condition of the improvement remained the same as on June 30, 1898, when the north jetty was completed for a total length of 2,705 feet and the south jetty for 1,790 feet. The Plum Island dike is 817 feet long, 5½ feet high above mean low water, except near the center, where a weir 150 feet long and 2 feet above mean low water was left temporarily. The sand catch in rear of the south jetty is in two branches, one 480 feet long and one 572 feet long.

Under the appropriation for this work made by the act of March 3, 1899, the south jetty has been extended 260 feet and the outer end of the north jetty, which had been torn down in places by storms, was repaired.

Nothing has yet been done toward the removal of North Rock, but a survey of it will soon be made to obtain the necessary data for preparing specifications for the work. Such further appropriations as are provided will be expended in the extension of the north and south jetties and in the completion of the dike.

July 1, 1899, balance unexpended	$26,337.38
June 30, 1900, amount expended during fiscal year	16,616.46
July 1, 1900, balance unexpended	9,720.92
July 1, 1900, outstanding liabilities	5,923.83
July 1, 1900, balance available	3,797.09
Amount (estimated) required for completion of existing project	264,047.49
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 6.)

7. *Merrimac River, Massachusetts.*—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 21½ miles, or to the foot of the Upper Falls, 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in this improvement.

Before improvement the channel was narrow and crooked and much obstructed by ledges, bowlders, and shoals. At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth.

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4.6 feet.

Since 1828 the channel of the river has been improved under a succession of projects, the principal one, dated 1870 and modified in 1874, providing for a channel with the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge, 5 miles, 16½ feet; thence to Haverhill Bridge, 12½ miles, 12 feet; thence to the foot of Mitchells Falls, Hazeltine Rapids, 1½ miles, 10 feet; thence through Mitchells Falls to the head of the Upper Falls, 2½ miles, not less than 4½ feet when the mill water at Lawrence is running.

The total appropriations to date are $287,366.72.

The expenditures to June 30, 1899, were $247,248.07.

On May 5, 1897, a project was submitted for a channel 150 feet wide and 7 feet deep at mean low water from Newburyport to Haverhill, in accordance with the river and harbor act of June 3, 1896. This project was estimated to cost $171,442.70. On June 30, 1898, all other projects but this had been completed.

The river and harbor act of March 3, 1899, appropriated $40,000 for improving Merrimac River in accordance with the project of May 5, 1897 (printed in the Annual Report of the Chief of Engineers for 1897, p. 865), and on June 28, 1899, a project for the expenditure of this appropriation was submitted, proposing to dredge the channel in the upper part of the river to full projected width of 150 feet and depth of 7 feet at mean low water for as great a distance as the funds would admit of.

At the date of this report no work has been done under the project of May 5, 1897. The work was advertised and contract let in 1899, under which operations were to begin in the spring of 1900. The contractor failed to commence the dredging as required, and the contract was annulled May 29, 1900. The work is now about to be readvertised. With such additional appropriations as may be provided dredging and removal of bowlders will be continued.

The commerce involved in this improvement consists of supplies of coal, lumber, etc., for cities and towns situated on its banks to the head of navigation. The amount of coal reported in 1899 was 52,000 tons.

July 1, 1899, balance unexpended	$40,118.65
June 30, 1900, amount expended during fiscal year	37.04
July 1, 1900, balance unexpended	40,081.61
Amount (estimated) required for completion of existing project	131,442.70
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	37,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 7.)

8. *Powow River, Massachusetts.*—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Powow River is a tributary of the Merrimac River, which it enters from the north about 3½ miles above Newburyport. From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, estimated in 1897 to cost $100,000. The object of the improvement is to secure a navigable low-water channel to the wharves at Amesbury.

The total appropriations to date have been $51,000.

The expenditures to June 30, 1899, were $38,982.32. At that date the projected 9,600-foot channel was 12 feet deep at mean high water, 45 feet wide for 2,934 feet from its upper end, and at least 30 feet wide for the remaining distance down river. In addition to the above, the channel had been dredged 45 feet wide and 12 feet deep at mean high water for a distance of 318 feet above the upper limit of the 9,600-foot channel.

During the past fiscal year the 45-foot width of channel has been extended down river a distance of 3,490 feet.

July 1, 1899, balance unexpended	$12,017.68
June 30, 1900, amount expended during fiscal year	7,561.92
July 1, 1900, balance unexpended	4,455.76
July 1, 1900, outstanding liabilities	294.97
July 1, 1900, balance available	4,160.79

Amount (estimated) required for completion of existing project	49,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	36,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 8.)

9. Essex River, Massachusetts.—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Essex River empties into Ipswich Bay about 3 miles southeast of the mouth of Ipswich River, Massachusetts. It was originally navigable at high water to the wharves in the town of Essex, a distance of 6 miles, but no navigable low-water channel existed for 12,000 feet below the town wharves.

The mean rise or fall of the tide is 8.8 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The project for improvement was submitted May 15, 1891, and proposed a channel 60 feet wide and 4 feet deep at mean low water to the railroad bridge in Essex, at an estimated cost of $25,000. On March 23, 1899, this project was modified so as to limit the present improvement to that portion of the channel lying below the drawbridge in Essex.

The total appropriations to date have been $25,000.

The expenditures to June 30, 1899, were $14,723.78. At that date the channel had been dredged to its full projected depth, 60 feet wide for 4,000 feet below the drawbridge, and at least 25 feet wide for the remaining distance below that bridge.

The river and harbor act of March 3, 1899, appropriated $10,000 for completing the improvement of this river, and contract for the work has been entered into. No other operations have been in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1899.

July 1, 1899, balance unexpended	$10,276.22
June 30, 1900, amount expended during fiscal year	40.00
July 1, 1900, balance unexpended	10,236.22
July 1, 1900, amount covered by uncompleted contracts	6,000.00
July 1, 1900, balance available	4,236.22

(See Appendix B 9.)

10. Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Sandy Bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is about 2¾ miles by 2 miles in area, and is fully protected on the west and south by high hills, but fronts the northeast and is open to the full effects of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a national harbor of refuge of the first class. The anchorage covered by the breakwater will contain 1,377 acres.

The estimated cost of the improvement is $5,000,000. The original project of 1884 proposed to build only the substructure of the breakwater of rubblestone. The present project, approved March 17, 1892, proposes to build the entire breakwater of rubblestone, the portion below low water to be built of stone of less than 4 tons weight, the upper portion of stone averaging 6 tons weight.

A plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1892, page 564.

The total appropriations to date have been $1,150,000.

The total expenditures to June 30, 1899, were $896,936.10. At that date 1,145,292 tons of rubblestone had been placed in the breakwater, and its condition was as follows:

Continuing successively from the initial point of the southern arm of the breakwater on Averys Ledge, for a distance of about 240 feet nothing had been done, then about 550 feet was built up to 22 feet below mean low water, about 2,250 feet more to mean low water and the remainder of the distance to the angle at Abners Ledge, about 500 feet, completed to mean high water. Beginning at this point the western arm was completed for a distance of 2,100 feet to 22 feet below mean low water, 40 feet wide on top.

During the past fiscal year 57,055 tons of rubblestone has been deposited in the substructure of the southern arm of the breakwater, raising the 550-foot section that was at 22 feet below mean low water on June 30, 1899, to mean low water, except for a distance of 250 feet where it is 3 feet below mean low water.

The river and harbor act of March 3, 1899, appropriated $250,000 for this work and provided that the Secretary of War should appoint a Board of three engineers to examine the project and report whether any modification of the same should, in their judgment, be made, with an estimate of the cost of completing the same. The Board was apppointed March 16, 1899, and its full report was printed in House Doc. No. 453, Fifty-sixth Congress, first session. It is also submitted as Appendix B 19 of this report.

This Board reported that the plan of substructure embodied in the present general project has given general satisfaction and requires no change. It also submitted a detailed project for carrying on the work with reference to both superstructure and substructure, estimating the cost of completion, exclusive of the part already built and contracted for, at $5,891,832.70.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property and a consequent reduction in freight and insurance.

July 1, 1899, balance unexpended		$253,063.90
June 30, 1900, amount expended during fiscal year		31,998.74
July 1, 1900, balance unexpended		221,065.16
July 1, 1900, outstanding liabilities	$9,846.31	
July 1, 1900, amount covered by uncompleted contracts	58,555.35	
		68,401.66
July 1, 1900, balance available		152,663.50
Amount (estimated) required for completion of existing project		3,850,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		350,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 10.)

11. Harbor at Gloucester, Mass.—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Gloucester Harbor, an important center for the fishing fleet of New England, is about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly gales.

The project of 1871 proposed the removal of certain bowlders from the inner harbor and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal.

The project of 1884 provided for two breakwaters at the entrance of Gloucester Harbor, one to cost $752,000, on essentially the same site as that proposed in 1871, and a supplementary one, through Normans Woe Rock, to cost $607,000.

In the annual report for this harbor for 1887 a general project for its improvement was submitted, based on the survey provided for by the act approved August 5, 1886. This project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of $65,000, and to construct the breakwater recommended in the project of 1884 that extends from Eastern Point to Round Rock Shoal, at an estimated cost of $752,000. In 1898 the form of breakwater was modified and estimated cost reduced to $698,083.43.

On May 5, 1897, a project was submitted for the removal of a pinnacle rock in the outer harbor to a least depth of 16 feet below mean low water, and rocks off the ferry landing at Rocky Neck to a level of the surrounding bottom. This work was authorized by the river and harbor act of June 3, 1896.

The total appropriations to date are $194,000.

The expenditures to June 30, 1899, were $153,628.52.

The condition of the improvement June 30, 1899, was as follows:

Clam Rock had been reduced from 1 foot to 9½ feet at mean low water; Pinnacle Rock from 8½ to 16½ feet, mean low water; rock off Pew's wharf from 2 to 5 feet, mean low water; rocks off J. Friend's wharf from 13 to 17 feet, mean low water. All of the above rocks were reduced to the level of the surrounding bottom. Babsons Ledge had been reduced from 11 to 14 feet, mean low water. A pinnacle rock in the outer harbor had also been removed to a depth of 16 feet below mean low water and rocks off the ferry landing at Rocky Neck had been reduced to the level of the surrounding bottom.

All the proposed dredging and rock removal had been done, the cost being about $15,000 more than the original estimate ($65,000), and the construction of the breakwater from Eastern Point to Round Rock Shoal was in progress; 90,800 tons of rubblestone had been deposited in the breakwater, and about 1,650 feet of the substructure had been completed to the cross section proposed in the project of 1887.

The movement of the vessels in the inner harbor had been greatly facilitated, but no benefit had been derived from work on the breakwater, as no sheltered anchorage had been obtained.

The river and harbor act of March 3, 1899, appropriated $40,000 for continuing this improvement, and on June 17, 1899, a project for the expenditure of this sum in continuation of construction of the breakwater was approved.

Operations have been in progress during the past fiscal year and consisted in widening the section of substructure already built. Work on the superstructure was also begun.

On June 30, 1900, 15,886 tons of rubblestone had been placed in the 1,650 feet of substructure already built, widening this portion of it to the full cross section proposed by the revised project; 10 tons of dimension stone had been placed in the superstructure.

The work in its present stage has greatly benefited the fishing industry, and its completion will furnish much needed sheltered anchorage in this important harbor.

A line of passenger and freight steamers is operated continuously throughout the year, and other commerce exists in the form of imports of salt, coal, lumber, etc. The estimated value of this commerce is $5,000,000 annually.

The following gross tonnage of shipments and receipts is reported for the past three years:

	Tons.
1897	82,600
1898	86,050
1899	287,922

July 1, 1899, balance unexpended		$40,371.48
June 30, 1900, amount expended during fiscal year		15,746.21
July 1, 1900, balance unexpended		24,625.27
July 1, 1900, outstanding liabilities	$1,658.06	
July 1, 1900, amount covered by uncompleted contracts	21,823.95	
		23,482.01
July 1, 1900, balance available		1,143.26
Amount (estimated) required for completion of existing project		584,083.43
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 11.)

12. *Harbor at Manchester, Mass.*—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts. The channel was 100 feet wide and 6½ feet deep at mean low water up to Proctors Point. It then shoaled rapidly to a depth of 1½ feet at The Narrows, 1,400 feet from Proctors Point, and for a farther distance of 2,500 feet to the town wharves no low-water channel existed.

The original project, that of 1887, proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water from Proctors Point to the town wharves, at an estimated cost of $14,300. This project was completed in April, 1894, giving a channel of full projected width and depth, with an additional width of 80 feet opposite the town wharf.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, page 466.

The present approved project of improvement was adopted March 3, 1899, and was printed in the annual report for 1897, page 869. It proposes to dredge the natural channel to a least width of 75 feet, and two turning basins, one just below the railroad bridge and one at the town landing, all 6 feet deep at mean low water, at an estimated cost of $25,000.

The total appropriations to date have been $19,300.

The expenditures to June 30, 1899, were $14,300. The condition of the improvement at that date remained the same, no work having been done since 1894.

During the past fiscal year operations were in progress under the last project. Dredging began at Proctors Point, the channel from that point down to the 6-foot contour in the bay, a distance of 3,200 feet, being increased where necessary to the full projected width and depth.

The available depth at mean low water that can be carried up to the town wharves is 4 feet.

The commerce involved in this improvement consists of supplies of coal, lumber, etc., for local consumption, about 10,000 tons being reported received in 1899. The improvement in its present condition has greatly facilitated the approach of vessels to the town wharves.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	4,747.78
July 1, 1900, balance unexpended	252.22
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 12.)

13. *Repair of sea wall at Marblehead, Mass.*—[This work was in the charge of Col. Chas. R. Suter, Corps of Engineers, until September 30, 1899.] Marblehead, Mass., is about 12 miles north of Boston, Mass. A part of the town is situated on Marblehead Neck, a peninsula lying east of the mainland and connected therewith by an isthmus about 2,000 feet long and a least width of 105 feet between high-water lines, which forms the southern bound of Marblehead Harbor.

This isthmus is traversed by a highway which is protected for about 1,900 feet of its length by a sea wall of light construction, reported to have been built by the United States Government in the early part of the present century.

A survey of the isthmus was made in September, 1896, and a report and plan of this survey were submitted to the Department on February 4, 1897, and were published in House Doc. No. 289, Fifty-fourth Congress, second session; also in the Annual Report of the Chief of Engineers, for 1897, page 870.

The river and harbor act of March 3, 1899, appropriated $1,000 for the repair of the sea wall at Marblehead, made necessary by the great storm of November, 1898.

There were no expenditures up to the close of the fiscal year ending June 30, 1899.

During the year an examination of the sea wall was made at a total cost of $8.33 and a report, to the effect that no repairs are needed, was submitted. No other operations were in progress.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	8.33
July 1, 1900, balance unexpended	991.67

(See Appendix B 13.)

14. *Removing sunken vessels or craft obstructing or endangering navigation.*—Under the provisions of sections 19 and 20 of the river and harbor act of March 3, 1899, the wreck of the schooner *Ellen Maria* was removed from entrance to Lynn Harbor, Massachusetts, in November, 1899, at a total cost of $750.60.

(See Appendix B 14.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by act of March 3, 1899, were made by the local officers and reports thereon submitted:

1. *Preliminary examination of Pull-and-be-damned Point, Portsmouth Harbor, New Hampshire, with a view to its removal, so far as the same is an obstruction to navigation.*—Maj. S. W. Roessler, Corps of Engineers, submitted report dated June 14, 1899. In his opinion, concurred in by the Division Engineer, Col. G. L. Gillespie, Corps of Engineers, and by me, the locality is not worthy of improvement by the General Government at the present time. The report was transmitted to Congress and printed in House Doc. No. 39, Fifty-sixth Congress, first session. (See also Appendix B 15.)

2. *Preliminary examination and survey of Isles of Shoals, Maine and New Hampshire, with a view to building a breakwater from Smutty Nose Island to Cedar Island.*—Report of preliminary examination was submitted by Major Roessler, June 14, 1899, and report on survey by his successor, Maj. W. L. Fisk, Corps of Engineers, December 21, 1899. Major Fisk presents a plan of improvement at an estimated cost of $30,000. The reports were transmitted to Congress and printed in House Doc. No. 255, Fifty-sixth Congress, first session. (See also Appendix B 16.)

3. *Preliminary examination and survey of piers and breakwater at Rockport, Mass.*—Report on preliminary examination was submitted by Col. Chas. R. Suter, Corps of Engineers, June 26, 1899, and report on survey by his successor, Major Fisk, January 19, 1900. A plan for improvement at an estimated cost of $22,481.80 is presented by Major Fisk. The reports were transmitted to Congress and printed in House Doc. No. 363, Fifty-sixth Congress, first session. (See also Appendix B 17.)

4. *Preliminary examination of Beverly Harbor, Massachusetts.*—Colonel Suter submitted report dated August 9, 1899. It is the opinion of Colonel Suter, concurred in by me, that this harbor is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 52, Fifty-sixth Congress, first session. (See also Appendix B 18.)

REPORT OF BOARD OF ENGINEERS ON PROJECT FOR IMPROVEMENT OF HARBOR OF REFUGE AT SANDY BAY, CAPE ANN, MASSACHUSETTS, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1899.

A Board of Engineers, constituted in accordance with requirements of the act of March 3, 1899, to examine and report upon the project for improving the harbor of refuge at Sandy Bay, Cape Ann, Massachusetts, with estimate of cost of completing said improvement, submitted reports dated July 3, 1899, and January 13, 1900. A detailed project for carrying on the work is presented, the estimated cost of its completion being given as $5,891,832.70, which is exclusive of the part already built and contracted for, but includes contingencies. The reports were transmitted to Congress and printed in House Doc. No. 453, Fifty-sixth Congress, first session. (See also Appendix B 19.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Beverly Harbor, Massachusetts, with a view to the straightening, widening, deepening, and otherwise improving the entrance to the approaches to the wharves and docks therein.

2. Hendersons Point, Portsmouth Harbor, New Hampshire, with a view of removing a portion of said point for the purpose of improving navigation to the navy-yard.

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS SOUTH OF AND INCLUDING LYNN HARBOR.

This district was in the charge of Col. Chas. R. Suter, Corps of Engineers, having under his immediate orders Lieut. Chas. S. Bromwell, Corps of Engineers, to April 5, 1900, and Lieut. Robert R. Raymond, Corps of Engineers, the entire year.

1. Harbor at Lynn, Mass.—[This work was in the charge of Maj. W. L. Fisk, Corps of Engineers, from September 30, 1899, to March 31, 1900.] Lynn Harbor is situated 9 miles northeast from Boston. It is approximately 1 by 2 miles in extent, of which the greater part is dry at low tide.

It is protected on the north and west by the mainland, on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay is on the south side.

Before improvement three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is 9.3 feet.

The original project of improvement was submitted in 1884 and proposed to excavate a channel 3,610 feet long, 200 feet wide, and 10 feet deep at mean low water from a point near and east of White Rocks to deep water opposite Little Nahant; and a channel 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water, from deep water, opposite Sand Point, to the harbor commissioner's line. A training wall about 6,000 feet long was also proposed, to start from the shore line at Little Nahant and to cross Black Rock Channel, its outer portion to be parallel to the outer improved channel, its purpose being to aid in keeping the outer channel open.

The cost of this project was first estimated to be $145,000, but the estimate was increased in 1885 to $157,000.

A plan of the harbor, showing the projected improvement, was published in the Annual Report of the Chief of Engineers for 1884, page 532.

The river and harbor act of August 11, 1888, authorized the extension of the main ship channel 400 feet within the harbor line and the excavation at its inner end of a basin 500 by 300 feet in area 10 feet deep at mean low water, increasing the total cost of the improvement to $182,000.

In accordance with the provisions of the river and harbor act of June 3, 1896, a survey of this harbor was made in October, 1896, "with a view to securing a channel 300 feet wide and 15 feet deep at low water," and in 1897 a project was submitted estimating the cost of the work to be $441,813.07. The report of this survey is published in House Doc. No. 28, Fifty-fifth Congress, first session; also in the Annual Report of the Chief of Engineers for 1897, page 872.

The total appropriations for this work to date have been $128,500.

The total expenditures to June 30, 1899, were $116,094.20 on the main project and $5,000 on the western or Saugus River Channel, and at that date all dredging under approved projects had been completed.

No operations have been in progress during the fiscal year, and at the date of this report the approved project has been completed, excepting the construction of the training wall, the necessity for which is not yet apparent.

The commerce involved in the improvement consists of coal, lumber, and other domestic and manufacturing supplies, and the improvement has enabled them to be brought in large vessels, thereby reducing freights and costs.

The value of the commerce for the fiscal year ending June 30, 1900, was $869,254.

July 1, 1899, balance unexpended	$7,405.80
June 30, 1900, amount expended during fiscal year	381.44
July 1, 1900, balance unexpended	7,024.36

(See Appendix C 1.)

2. *Mystic and Malden rivers, Massachusetts.*—Mystic River empties into the inner harbor of Boston, Mass., and extends from the navy-yard to the town of Medford, a distance of about 4½ miles. Malden River is about 2 miles long from the town of Malden to its junction with Mystic River, about 3 miles above the navy-yard.

Originally Mystic River had no navigable low-water channel. A project for its improvement was submitted May 9, 1891. It proposed to widen and deepen the natural channel of the river so that it should be 100 feet wide and 6 feet deep at mean low water to the first turn above Denning's wharf, and thence to the head of navigation 4 feet deep, with the width gradually reduced to 50 feet at Craddock's bridge.

The cost of this improvement was estimated to be $25,000.

Originally in the Malden there was a narrow and exceedingly crooked channel, with a navigable depth of barely 7 feet at mean high water. The rise of the tide is 9.8 feet. The original project for its improvement, proposed December 1, 1880, contemplated the excavation of a channel 100 feet wide and 12 feet deep at mean high water up to the second drawbridge, with two cut-offs, one east of the island, near the junction of the Malden and Mystic rivers, and the other through the marsh land about half a mile above; estimated cost, $35,000. This project, as modified in 1882, proposed to make the natural channel 100 feet wide and 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge; estimated cost, $40,000. This estimate was increased to $47,000 in 1884. (Annual Report of the Chief of Engineers for 1884, p. 551.)

Ten thousand dollars, appropriated for this work by the act of 1882, was expended (1883–84) in making the channel from the mouth to the drawbridge in Malden, a distance of 1¼ miles, at least 50 feet wide (70 feet at turns) and 12 feet deep at mean high water. On November 1, 1890, a project was submitted for the improvement of this river in conjunction with Mystic River. This project proposed the completion of the project of 1882, at an estimated cost of $37,000.

The total appropriations to date have been $45,000 for both rivers.

The expenditures to June 30, 1899, were $39,973.08, and at that date the improved channel in Mystic River had been dredged to full projected width and depth from the mouth to 5,200 feet above Denning's wharf, and the improved channel in Malden River had been dredged to the full projected depth and width up to the first bridge. Nothing has been done above this bridge.

No operations have been in progress on Mystic River during the fiscal year, for the reason that the expenditure of the small sum available would result in no material benefit to navigation.

During the month of September, 1899, a shoal which had formed in the improved channel of Malden River was removed under informal agreement with the Eastern Dredging Company, at a cost of $938.72.

The channel of this river has shoaled so that the greatest continuous depth is now but 10 feet at mean high water.

The commerce involved in this improvement is that of the cities of Charlestown and Medford, on the Mystic River, and of the city of Malden, on the Malden River.

To complete the improvement of Mystic River will require an appropriation of $7,500, and of Malden River $19,500, a total of $27,000.

An allotment of $5,000 from the appropriation contained in the emergency river and harbor act of June 6, 1900, for the restoration of the channel of the Malden River was made July 19, 1900.

July 1, 1899, balance unexpended	$5,026.92
June 30, 1900, amount expended during fiscal year	993.86
July 1, 1900, balance unexpended	4,033.06
Amount (estimated) required for completion of existing project	27,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	27,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 2.)

3. *Mystic River, Massachusetts, below the mouth of Island End River.*—Mystic River empties into the inner harbor of Boston, near the Charlestown Navy-Yard. For about 6 miles in length its channel is navigable to vessels, and the cities of Charlestown, Somerville, Medford, Everett, Chelsea, and East Boston have water frontage on its channel in this length.

In its present condition about 18 feet draft at mean low water can be carried to the mouth of Island End River.

The project for improvement was submitted January 18, 1899, and proposed to dredge a channel 300 feet wide and 25 feet deep at mean low water from the upper end of the main ship channel in Boston Harbor to the mouth of Island End River, 3,500 feet above Chelsea Bridge, at an estimated cost of $321,445.52.

This estimate was reduced to $267,547.50 on August 23, 1899, as the result of a new survey of the locality made in the summer of 1899.

The only appropriation to date is that of $50,000 by the river and harbor act of March 3, 1899.

The expenditures to June 30, 1899, were $493.45.

At that date no work had been done under the project.

During the fiscal year dredging has been in progress under a contract dated November 8, 1899, with Charles H. Souther, of Boston, Mass., to dredge 200,000 cubic yards of material from the river. On completion of this contract (by October 31, 1900) a channel 100 feet wide and 25 feet deep at mean low water will have been secured to the mouth of Island End River.

The water frontage on both sides of the section of Mystic River included in this improvement is rapidly increasing in commercial importance, and the completion of the improvement will open this channel to vessels of much greater draft and tonnage.

July 1, 1899, balance unexpended		$49,506.55
June 30, 1900, amount expended during fiscal year		23,254.74
July 1, 1900, balance unexpended		26,251.81
July 1, 1900, outstanding liabilities	$3,382.92	
July 1, 1900, amount covered by uncompleted contracts	22,434.34	
		25,817.26
July 1, 1900, balance available		434.55
Amount (estimated) required for completion of existing project		217,547.50
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		170,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 3.)

4. *Harbor at Boston, Mass.*—Boston Harbor consists essentially of an inner and outer harbor united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

(1) *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into the basin—the Charles, Mystic, and Chelsea rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

(2) *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads as well as in Hingham Bay, a well-sheltered harbor southeast of Paddocks Island. It connects with the inner harbor by the main ship channel, through the Narrows, and by secondary channels east and west of Long Island. It is reached

from the sea by Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands which shelter the anchorages from winds and storm waves.

The range of the tide at the navy-yard is 9.8 feet and at the entrance to the outer harbor 9.4 feet. A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to preserve the harbor by protecting the islands and headlands, and, second, to improve it by widening, deepening, and straightening the channels.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $4,080,027.10.

The total expenditure to June 30, 1899 (not including outstanding liabilities), was $2,977,243.39.

Works of preservation.—The location and details of these works are given in the Annual Report of the Chief of Engineers for 1895, pages 621 and 622.

The severe storms of the winter of 1898–99 seriously damaged many of the sea walls, making extensive repairs necessary.

During the fiscal year repairs were made to the sea walls at Georges, Long, and Lovells islands, and a section of the riprap at Gallops Island was rebuilt.

At the date of this report repairs are being made to the sea wall at Rainsford Island, and repairs to the sea walls on Deer Island and Castle Island are required. These repairs will be undertaken during the ensuing year.

Works of improvement.—The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed and the main ship channel enlarged from 100 feet wide and 18 feet deep at mean low water, so that the upper channel on June 30, 1899, was at least 850 feet wide and 23 feet deep at mean low water throughout and the lower main ship channel to President Roads was 27 feet deep at mean low water, 1,000 feet wide from the entrance to President Roads, but a section of the channel between Georges and Lovells islands, for about 250 feet of its width on the southern side, is obstructed by ledges, which must be removed before free use of the full width of channel can be obtained.

The following tributary channels have also been improved, and their condition on June 30, 1899, was as follows:

a. Charles River.—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth to Western Avenue Bridge, a distance of 4¾ miles, the channel has a width of 200 feet and a depth of 7 feet at mean low water. Thence to Arsenal Street Bridge, 2½ miles, the channel has a least width of 80 feet and a least depth of 6 feet.

By the act of September 19, 1890, $20,000 was appropriated for the improvement of Charles River, provided "that the draws in the Arsenal Street and Market Street bridges shall be made to conform to the projected channel without cost to the United States." This sum still remains unexpended because the Market Street Bridge has not been remodeled.

b. Fort Point Channel.—This important branch of the main ship channel had a least depth of 12 feet at its entrance, and the channel was narrow and crooked. The project for its improvement was submitted January 27, 1885. It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost $100,000, the railroad bridge to be reconstructed at the expense of the owners. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress Street Bridge, a distance of 1,900 feet.

This improvement can now be continued if appropriations are made therefor, as the railroad bridge has been removed and a new bridge constructed.

c. Nantasket Beach Channel.—This channel was originally about 50 feet wide and 8 feet deep at mean low water. It is now 150 feet wide and 12 feet deep at mean low water.

d. Channel between Nixs Mate and Long Island.—This channel had originally 4½ feet depth at mean low water. A cut has been made through the bar 300 feet wide, and 15 feet deep at mean low water.

e. Broad Sound.—An obstruction called Barrel Rock was removed in 1869.

f. Jeffreys Point Channel.—This channel is an extension of the main ship channel from near Grand Junction Wharf (East Boston) toward Jeffreys Point. It is now 400 feet wide from Grand Junction Wharf to just east of Simpson's patent dry docks and 18 feet deep at mean low water, thence gradually narrowing to 250 feet and decreasing in depth of water to 15 feet at mean low water at a junction with the same depth off Jeffreys Point.

g. Chelsea Creek.—This tributary empties into the upper part of Boston inner harbor and lies between East Boston and the city of Chelsea. It had originally but 14 feet at mean high water in a narrow channel very difficult of navigation. The project of improvement proposed to dredge a channel 150 feet wide and 18 feet deep at mean high water to the head of navigation. At the date of this report the channel is 14 feet deep at mean high water, at least 35 feet wide, and of greatly increased width at turns.

No operations have been in progress in any of these tributary channels during the fiscal year.

Under the project of 1867 there remains to be appropriated for completion of sea walls of Point Allerton, Georges Island, and Governors Island $112,000, and for completion of improvement of subsidiary channels of Charles River, Fort Point, and Chelsea Creek $160,500, making a total of $272,500. Work remaining to be done under the project of 1867 is not included in the project of 1892 or covered by the continuing contracts authorized by the acts of June 3, 1896, and March 3, 1899.

On June 30, 1899, operations were in progress under a continuing contract with Messrs. Breymann Brothers, of Toledo, Ohio, to dredge 2,910,718 cubic yards, more or less, of material from the main ship channel, in completion of all dredging under the project of August 11, 1892.

This contract was authorized by the river and harbor act of June 3, 1896.

During the fiscal year 875,505 cubic yards of material was dredged, principally from the upper main ship channel, resulting in a channel 27 feet deep and 500 feet wide up to the anchorage near the city wharves. This channel, however, is obstructed by ledges at the "Upper Middle," which deprive vessels of the benefit of the increased depth of water, but at the date of this report bids for the removal of these ledges are being advertised for, to be opened July 16, 1900, and it is expected that by December 31, 1900, a navigable channel of 27 feet depth at mean low water will have been secured from the sea to the city wharves.

The lower main ship channel at the date of this report is in the same condition as on June 30, 1899.

The river and harbor act approved June 3, 1896, provided for a survey of Boston Harbor, with a view of securing a channel 1,200 feet wide and 30 feet deep from the navy-yard to the entrance of the main ship channel, and from the main ship channel in President Roads through Broad Sound Channel. The report upon this survey is printed in Annual Report of the Chief of Engineers for 1898, page 887, and contains an estimate amounting to $481,941.57 for securing a channel of the required dimensions through Broad Sound Channel and President Roads to Boston Upper Harbor. With this report before it, Congress inserted in the river and harbor act of March 3, 1899, the following provision, embodying it in the item appropriating $75,000 for improving Boston Harbor:

> *Provided further,* That the Secretary of War may use five thousand dollars thereof and enter into a contract or contracts for such materials and work as may be necessary for the completion of the improvement in accordance with the project recommended in the report printed on pages 1887 et sequentes of the Report of the Chief of Engineers for 1898; such improvement to provide for a channel one thousand two hundred feet wide and thirty feet deep from the main ship channel in President Roads through Broad Sound Channel, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate four hundred and fifty thousand dollars, exclusive of the amount herein and heretofore appropriated.

Under the above authority, on March 13, 1900, a contract was entered into with Breymann Bros., of Toledo, Ohio, to perform all dredging under the project.

The sundry civil act of June 6, 1900, appropriated $317,000 for this work, and the work of dredging will be commenced during July, 1900.

This amount will cover all work of dredging under the contract of March 13, 1900, but the $113,000 balance of the authorized amount to be expended on the improvement will be required for removal of ledges which will be uncovered by the dredging.

Boston Harbor is one of the most important ports on the Atlantic coast. The amount of revenue collected during the year ending June 30, 1899, was $15,689,276.26 and in 1900 $18,871,848.99.

Of the balance available July 1, 1900 ($98,312.16), $20,000 is to be expended in the improvement of Charles River, $10,000 upon survey of Boston Harbor, directed by the emergency river and harbor act approved June 6, 1900, and the remainder in repairs to sea walls and maintenance of works of improvement. Additional funds, if appropriated, will be expended upon work for completion of the improvement of Charles River, Fort Point Channel, and Chelsea Creek; also upon sea walls at Point Allerton, Governors Island, and Georges Island.

PROJECT FOR GENERAL IMPROVEMENT.

July 1, 1899, balance unexpended		$118, 873. 92
June 30, 1900, amount expended during fiscal year	$15, 061. 76	
Amount transferred to Broad Sound	5, 000. 00	
		20, 061. 76
July 1, 1900, balance unexpended		98, 812. 16
July 1, 1900, outstanding liabilities		500. 00
July 1, 1900, balance available		98, 312. 16
Amount (estimated) required for completion of existing project		272, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		163, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

PROJECT OF 1892.

July 1, 1899, balance unexpended		$666, 909. 79
June 30, 1900, amount expended during fiscal year		157, 367. 62
July 1, 1900, balance unexpended		509, 542. 17
July 1, 1900, outstanding liabilities	$43, 394. 85	
July 1, 1900, amount covered by uncompleted contracts	153, 586. 25	
		196, 981. 10
July 1, 1900, balance available		312, 561. 07

PROJECT FOR BROAD SOUND CHANNEL.

Amount appropriated by sundry civil act approved June 6, 1900	$317, 000. 00
Amount transferred from general improvement	5, 000. 00
	322, 000. 00
June 30, 1900, amount expended during fiscal year	213. 27
July 1, 1900, balance unexpended	321, 786. 73
July 1, 1900, amount covered by uncompleted contracts	292, 628. 70
July 1, 1900, balance available	29, 158. 03
Amount (estimated) required for completion of existing project	133, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	133, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 4.)

5. *Town River, Massachusetts.*—Town River is a small tidal river debouching into Weymouth Fore River, and lies within the limits of the city of Quincy. It is about 1½ miles long from its mouth at Quincy Point to the upper wharves of the city.

The upper half of the river (three-fourths of a mile) has a very narrow and crooked channel, carrying about 1½ feet of water at low tide.

The project for the improvement of this river, submitted December 31, 1890, proposed to dredge a channel 4,500 feet long, 100 feet wide, and 4 feet deep at mean low water to the head of navigation, at an estimated cost of $20,000, increased in 1897 to $25,000.

The total appropriations to date have been $18,000.

The expenditures to June 30, 1899, were $9,757.43.

At that date the improved channel had been dredged 4 feet deep at mean low water, 50 feet wide for a length of 3,500 feet, and 30 feet wide for a further length of 800 feet.

The river and harbor act of March 3, 1899, appropriated $8,000 for continuing this improvement, and on July 12, 1899, a contract was entered into with Mr. Joseph E. White, of Quincy, Mass., to dredge 28,000 cubic yards, more or less, of material from the channel in continuation of the improvement.

Work under this contract was commenced on August 7, 1899, and was completed November 10, 1899. At the date of this report the channel has been dredged to a depth of 4 feet at mean low water, 50 feet wide for a distance of 1,000 feet below the upper end, 100 feet wide for a further distance of 2,200 feet, and at least 50 feet wide for its remaining length, but owing to deterioration of former work the available continuous depth at mean low water is only about 2.5 feet.

To restore the depth and width heretofore obtained under appropriations made by Congress for this work will require the removal of about 16,117 cubic yards of material, and this, it is estimated, will cost, with contingencies, $5,318.61, which amount is exclusive of the sum required to complete the adopted project.

The commerce involved in the improvement of this river consists of coal, lumber, etc., for the city of Quincy, and the output of the Quincy granite quarries shipped by water. The value of this commerce annually will approximate $200,000.

July 1, 1899, balance unexpended	$8,242.57
June 30, 1900, amount expended during fiscal year	7,966.02
July 1, 1900, balance unexpended	276.55
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix C 5.)

6. *Weymouth River, Massachusetts.*—Weymouth Fore River, tributary to Hingham Bay, Boston Harbor, Massachusetts, is one of the most important water courses on the south coast of Massachusetts Bay. It is navigable at low water for vessels not exceeding 18 feet draft for 4 miles from its mouth, and for a farther distance of 3 miles to the head of navigation at least 3 feet depth was found at mean low water before its improvement.

Weymouth Back River lies east of the Fore River, forming a portion of the boundary between the towns of Weymouth and Hingham. Its course is northerly, and it enters into Hingham Bay at the mouth of Weymouth Fore River.

The original project of improvement of Weymouth Fore River was submitted December 2, 1889. It proposed to improve the natural channel of the river by dredging, so that 6 feet depth at mean low water could be carried to the head of navigation in a channel 100 feet wide to near the wharves at Weymouth Landing; thence to Braintree Bridge 80 feet wide, and above the bridge 50 feet wide, with increased width at each turn to facilitate the movement of vessels. The total length of channel to be improved was 7,000 feet, approximately, and the cost was estimated to be $40,000.

The project for the improvement of Weymouth Back River was submitted February 7, 1891. It proposed to dredge a channel through the outer bar 200 feet wide and 12 feet deep at mean low water, and to widen and deepen the natural channel of the river to the same dimensions to the wharf of the fertilizer company, at an estimated cost of $22,000.

On March 15, 1897, a project for the improvement of this river from the Bradley Fertilizer Company's wharf up to Mann's wharf was submitted. It proposed a channel 60 feet wide, 4 feet deep at mean low water, at an estimated cost of $49,834.01.

This project was published in House Doc. No. 12, Fifty-fifth Congress, first session; also in the Annual Report of the Chief of Engineers for 1897, page 874.

No appropriation has as yet been made for its execution.

The total appropriations for this work to date have been $50,000, of which $12,500 must be expended in the Back River.

The expenditures to June 30, 1899, were $26,749.42 on Fore River, and $11,704.19 on Back River.

At that date the channel in Weymouth Fore River had been dredged 6 feet deep and 60 feet wide up to Braintree Bridge, and above the bridge had been completed except over a few small ledges, uncovered by the dredging in 1897.

In Weymouth Back River the channel had been dredged 12 feet deep at mean low water, 200 feet wide through the bar, and 125 feet wide thence to the wharf of the Bradley Fertilizer Company.

The passage of vessels in both rivers had been greatly facilitated.

The river and harbor act of March 3, 1899, appropriated $10,000 for continuing the improvement of Weymouth Fore River.

On July 12, 1899, a contract was entered into with Jos. E. White, of Quincy, Mass., to dredge 30,000 cubic yards, more or less, of material from Weymouth River.

Work under this contract was completed in June, 1900, and at the date of this report the channel of Weymouth Fore River has been dredged 6 feet deep at mean low water, of full projected width for a distance of 3,600 feet above its lower end, 60 feet wide for a further distance of 1,500 feet, and of full projected width for the remainder of its length; but owing to shoaling in the areas dredged over in former years, only 5 feet continuous depth exists at present in the channel. It is estimated that the work required to restore the depths and widths of channel obtained under the project will cost $5,576.67 in addition to the amount required to complete the existing project.

No work has been done in Weymouth Back River during the fiscal year, and its condition is the same as on June 30, 1899.

The character of commerce benefited by the improvement of this river is the supply of coal, lumber, and general merchandise to the populous district surrounding it. The annual value of this commerce approximates $750,000.

July 1, 1899, balance unexpended	$11,546.39
June 30, 1900, amount expended during fiscal year	10,622.99
July 1, 1900, balance unexpended	923.40
Amount (estimated) required for completion of existing project	12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix C 6.)

7. *Harbor at Scituate, Mass.*—Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth lighthouses, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres, approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston which are too far south of their course to clear the dangerous ledges near Minots Light-House.

The project of improvement, adopted in 1881, is to build two rubble-stone breakwaters converging from opposite shores, and to dredge an anchorage basin with channels connecting with the sea and the town wharves.

The north breakwater, from Cedar Point, is to be 800 feet long, and the south breakwater, from the point of the first cliff, is to be 730 feet long. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water, except at their outer ends, which are to be built 6 feet higher, to serve as sites for entrance beacons. The anchorage basin is to be 30 acres in area, approximately. The entrance channel, is to be 2,700 feet long and 300 feet average width. The depths proposed were 15 feet in the entrance channel, 12 to 15 feet between the breakwaters, 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin. The channel leading to the town wharves is to be 3 feet deep, all at mean low water.

The estimated cost of the breakwaters was $100,000 and of the dredging $190,000.

A plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, page 522.

The total amount appropriated for this work to date is $104,680, of which $1,180 was expended before the present project was adopted.

The expenditure to June 30, 1899, was $88,410.24.

At that time the condition of the improvement was as follows:

A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long. All known bowlders obstructing the entrance of the harbor were removed; the anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water; the entrance channel had been dredged 1,600 feet long, 100 feet wide, and 7 feet deep at mean low water; the channel connecting the basin with the town wharves had been dredged 3 feet deep at mean low water and 100 feet wide.

The north breakwater was 720 feet long; the south breakwater, 450 feet long.

A survey of the improvement made in April, 1899, showed that the channel of approach to the town wharves from the anchorage basin had shoaled and required redredging; and on June 20, 1899, a project for redredging this channel with funds appropriated by the river and harbor act of March 3, 1899, was approved.

On October 5, 1899, a contract was entered into for dredging 35,000 cubic yards, more or less, of material at 34.4 cents per cubic yard, from the harbor.

Work under this contract was commenced October 24, 1899, and completed December 13, 1899, and the channel of approach to the town wharves was made 3 feet deep at mean low water, at least 100 feet wide throughout, 200 feet wide for 1,200 feet of its length, and 250 feet wide at its departure from the anchorage basin.

No work was done on other parts of the project during the year, and at the date of this report their condition is the same as on June 30, 1899.

The commerce of the port consists of supplies of coal, lumber, etc., for local consumption, and approximates an annual value of $60,000, and the intent of the project is to secure a harbor of refuge at this point for vessels engaged in the coastwise trade.

July 1, 1899, balance unexpended	$15,089.76
June 30, 1900, amount expended during fiscal year	12,952.59
July 1, 1900, balance unexpended	2,137.17
Amount (estimated) required for completion of existing project	186,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and habor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 7.)

8. *Harbor at Duxbury, Mass.*—Duxbury Bay, Massachusetts, is the northerly of three divisions into which Plymouth Harbor is divided.

The town of Duxbury covers part of Kingston Bay, another of these divisions, and in 1872–1874 $20,000 was expended by the National Government in improving the Miles (or South) Channel, extending westward from the "Cow Yard" by the south point of Captains Hill. The expenditures since 1872 and up to June 30, 1898, for improvement of this harbor amount to $20,000.

The present approved project for the improvement of Duxbury Harbor, Massachusetts, was submitted November 8, 1886, and proposes to dredge the western branch of the Duxbury Channel to a least width of 60 feet and a depth of 6 feet at mean low water up to the town landing.

The length of channel to be dredged under this project is about 3,600 feet, and the estimated cost was $13,200.

The total appropriations to date for the current project are $12,000; the expenditures to June 30, 1899, were $336.60. At that date no work had been done under the project.

The river and harbor act of March 3, 1899, appropriated $12,000 for improving this harbor and for repairs made necessary by storms.

On April 1, 1899, the expenditure of $650 of this appropriation was authorized for the purpose of making a survey of the channel and beach, on which to base a project for the expenditure of the available funds.

The survey was completed in June, 1899, and on July 31, 1899, a project was submitted for the expenditure of the available funds, together with a revised general project for the improvement and an estimate of cost increased to $17,820. This revised project was necessary because of changed conditions since 1886 when the original project was submitted, and provides for a channel 6 feet deep at mean low water, 60 feet wide in the straight section, and 100 feet wide in the curved section.

This project was approved by the Secretary of War on August 12, 1899, and on October 19, 1899, a contract was entered into for dredging 44,000 cubic yards, more or less, of material at 23½ cents per yard.

Work under this contract was commenced November 1, 1899, and was completed June 16, 1900. Forty-three thousand nine hundred and twenty-eight cubic yards of material was dredged, resulting in the development of a channel 6 feet deep at mean low water, 40 feet wide in the straight section, 60 feet wide on the curve, and 80 feet wide at the wharf. The improvement gives an increased depth of 7 feet at mean low water at the wharf.

The commerce of this port consists of supplies of coal, lumber, etc., for local consumption and aggregates in value about $12,500.

July 1, 1899, balance unexpended	$11,663.40
June 30, 1900, amount expended during fiscal year	11,567.14
July 1, 1900, balance unexpended	96.26
Amount (estimated) required for completion of existing project	5,820.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	5,820.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 8.)

9. Harbor at Plymouth, Mass.—Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for seagoing vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, of ample width, and sufficiently deep. The anchorage is capacious and has good holding ground, but the extensive tidal basins inside of it give strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which extends generally parallel to the mainland and about 1 mile from it.

The harbor contains about 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked channels traverse these flats. They join about the center of the harbor, opposite the town wharves, and form the main ship channel (150 feet wide, approximately, and 10 feet deep at mean low water), which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, page 460.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

Previous to 1875 the project was a general one, and had for its object the preservation of Long Beach.

From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damages by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the channel and basin to 9 feet at mean low water and to make the channel 150 feet wide, at an estimated cost of $27,000, reduced in 1885 to $22,500.

On April 24, 1897, a plan and project for further improvement of the harbor were submitted, in accordance with the river and harbor act of June 3, 1896. This report and project were published in House Doc. No. 39, Fifty-fifth Congress, first session; also in the Annual Report of the Chief of Engineers for 1897, page 877.

From 1824 to date the amount appropriated for this harbor is $267,766.90, of which there had been expended to June 30, 1899—

For beach protection	$129,526.29
For dredging	50,738.10
Total	180,264.39

On June 30, 1899, the project of 1884–85 for improvement had been completed.

The severe storms of the winter of 1898–99 seriously damaged the protective works on Long Beach. The river and harbor act of March 3, 1899, appropriated $75,000 for repair of the storm damages in accordance with plans and estimate submitted January 20, 1899, and $10,000 for maintenance.

On June 5, 1899, the Secretary of War approved a project for expenditure of the $75,000 in building a rubblestone riprap on Long Beach, and on May 27, 1899, a project for expenditure of the $10,000 in redredging the improved channel and basin was approved.

On August 15, 1899, a contract was entered into for dredging 45,000 cubic yards of material from the improved channel and basin.

Work under this contract was completed in February, 1900, and at the date of this report the channel and basin are at least 150 feet wide and 9 feet deep at mean low water.

On August 18, 1899, a contract was entered into for depositing 45,000 tons of rubblestone in a riprap for the protection of Long Beach. At the date of this report about 550 running feet of riprap have been built and construction of the riprap is in progress.

The estimate of cost of this work submitted January 20, 1899, was $95,700, and this full amount will be required to restore the beach to its former condition.

The commerce of Plymouth Harbor consists of coal, lumber, etc., for local consumption, and approximates an annual value of $175,000. It is also a port of entry, and the annual revenue collected in 1900 was $1,224.88.

July 1, 1899, balance unexpended		$87,502.51
June 30, 1900, amount expended during fiscal year		16,212.33
July 1, 1900, balance unexpended		71,290.18
July 1, 1900, outstanding liabilities	$886.52	
July 1, 1900, amount covered by uncompleted contracts	56,371.39	
		57,257.91
July 1, 1900, balance available		14,032.27
Amount (estimated) required for completion of existing project		20,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		20,700.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 9.)

10. Harbor at Provincetown, Mass.—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic Coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed.

A full history of the improvement will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the annual report for 1886.

A survey of the harbor was made in October, 1896, and a plan of the harbor and report of this survey were submitted with a project for strengthening the beach near Wood End Light, estimated to cost $13,200. This plan and report were published in House Doc. No. 8, Fifty-fifth Congress, first session; also in the Annual Report of the Chief of Engineers for 1897, page 878.

The total appropriations to date have been $165,918.44.

The amount expended to June 30, 1899, was $150,433.15.

At that date works of preservation had been built at Long Point, near Wood End Light, near Abel Hill, and at Beach Point, High Head, and Cove Section, and these works were all in good order and were fulfilling the purpose for which they were built.

During the fiscal year 1,409 feet of bulkhead was added to the works of preservation at Wood End and 108 feet at Abel Hill, and minor repairs were made to old works at both points.

Extension of the works near Wood End Light and minor repairs near Abel Hill Dike are proposed during the present working season.

July 1, 1899, balance unexpended	$15,485.29
June 30, 1900, amount expended during fiscal year	3,669.75
July 1, 1900, balance unexpended	11,815.54

(See Appendix C 10.)

11. Harbor at Chatham, Mass.—Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage (Chatham Roads) is a valuable harbor of refuge from northerly and easterly gales. The inner harbor (Stage Harbor) is small, but well landlocked, and has 8 to 12 feet depth at mean low water. Its entrance was obstructed by three bars, on which the greatest depth at mean low water was 4 feet.

The project for the improvement of this harbor, submitted December 19, 1890, proposed to dredge a channel through the three obstructing bars 6 feet deep at mean low water, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at a cost of $10,000, increased in 1897 to $13,732.79.

The total appropriations to date have been $13,732.79.

The expenditure to June 30, 1899, was $4,426.10.

At that date the improved channel through the middle and inner bars had been dredged 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar. At least 5 feet draft could be carried into the harbor at mean low water.

In this condition the improvement has facilitated the navigation of the harbor to a considerable extent.

The river and harbor act of March 3, 1899, appropriated $3,732.79 for the completion of this improvement, and on June 28, 1899, bids were received and opened for the proposed dredging.

On July 12, 1899, a contract was entered into for dredging 25,000 cubic yards of material, at 32 cents per cubic yard.

Work under this contract was to have been commenced by August 20, 1899, and was to have been completed by June 30, 1900.

On May 14, 1900, the contract was annulled because of unsatisfactory progress, only 1,447 cubic yards having been dredged at that date.

The condition of the improvement at the date of this report is therefore the same as on June 30, 1899.

The work will be readvertised and the project probably completed during the present working season.

The character of the commerce involved in the improvement is the local fishing interest and supplies of lumber, coal, etc., for local consumption. The value of the commerce annually approximates $200,000.

July 1, 1899, balance unexpended	$9,306.69
June 30, 1900, amount expended during fiscal year	1,058.80
July 1, 1900, balance unexpended	8,247.89

(See Appendix C 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—Under the provisions of sections 19 and 20 of the river and harbor act of March 3, 1899, the wreck of a vessel, name unknown, was removed from Chatham New Harbor, Massachusetts, during July, 1899, at a total cost of $142.89, and during September, 1899, the wreck of schooner boat *Lydia Jane* was removed from Provincetown Harbor, Massachusetts, at a total cost of $131.09.

(See Appendix C 12.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and survey of the following localities, required by the act of March 3, 1899, were made by the local officer, Col. Chas. R. Suter, Corps of Engineers, and reports thereon submitted:

1. *Preliminary examination of Winthrop Harbor, Massachusetts, with a view to providing channels of a width of 75 and 100 feet, respectively, and a depth of 12 and 15 feet, respectively.*—Colonel Suter submitted report dated July 28, 1899. In his opinion, concurred in by me, the locality is not worthy of improvement by the General Government to the extent specified in the act. The report was transmitted to Congress and printed in House Doc. No. 135, Fifty-sixth Congress, first session. (See also Appendix C 13.)

2. *Preliminary examination and survey of Cohasset Harbor, Massachusetts.*—Colonel Suter submitted reports dated June 26 and Decem-16, 1899, respectively. The plan of improvement presented contemplates the dredging of a channel to the town wharves and a turning basin opposite the same at an estimated cost, including contingencies, of $21,670. The reports were transmitted to Congress and printed in House Doc. No. 284, Fifty-sixth Congress, first session. (See also Appendix C 14.)

3. Preliminary examination of Sandwich Harbor, Massachusetts.—Colonel Suter submitted report dated August 5, 1899. In his opinion, concurred in by me, the locality is not worthy of improvement by the General Government at the present time. The report was transmitted to Congress and printed in House Doc. No. 136, Fifty-sixth Congress, first session. (See also Appendix C 15.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Boston Harbor, Massachusetts, with a view to providing channels 2,000 feet wide, or such width as may be necessary, and 35 feet deep, from the navy-yard at Charlestown and the Chelsea Bridge and Charles River Bridge to President Roads, and from President Roads through Broad Sound Channel to the ocean.

2. Lynn Harbor, Massachusetts, with a view of securing a channel 200 feet wide and 15 feet deep at mean low water, including the basin extending beyond the inner ship channel, and the removal of a small point on the eastern bank of the channel near to said basin.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS AND IN RHODE ISLAND.

This district was in the charge of Maj. D. W. Lockwood, Corps of Engineers, having under his immediate orders Lieut. R. P. Johnston, Corps of Engineers. Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

1. Harbor of refuge at Hyannis, Mass.—This harbor before improvement was an open roadstead exposed to southerly storms. In the years 1827–1838 a breakwater 1,170 feet long was constructed of riprap granite, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15.5 feet. Between the years 1852 and 1882 extensive repairs were made, increasing the width of the base of the breakwater and the size of the stone forming its sides and top.

The approved project of 1884 provided for dredging to 15.5 feet depth at low water about 36 acres area north of the existing breakwater, so as to increase the deep-water anchorage by that amount, all at a total cost estimated at that time at $45,743.20.

At the adoption of the present project the 15.5 feet depth anchorage covered only about 47 acres, and the 36 additional acres to be dredged carried an average of about 12 feet depth of water at low water.

The sum of $166,937.65 had been expended at this harbor up to June 30, 1899, of which $123,350.62 had been expended in construction and repairs to the breakwater and the remainder in dredging. Twenty-six and six-tenths acres of the 36 had been deepened to 15.5 feet, and two 25-feet-wide cuts, 13 feet deep at mean low water, had been made in the channel leading to the wharf of the New York, New Haven and Hartford Railroad Company.

No work was done during the past fiscal year except a survey of the locality for further improvement, report on which was submitted November 27, 1899, and printed in House Doc. No. 79, Fifty-sixth Congress, first session. It is also herewith as Appendix D 21. The project therein presented contemplates the completion of the project of 1884 at a cost of $32,500, and an estimate for this amount is accordingly submitted.

The principal value of this harbor to commerce is as a harbor of refuge for coasters and fishing vessels. The actual commerce of the place consists of general agricultural products, coal, and fish, aggregating 28,000 tons. The increase of anchorage area will afford refuge for more and larger boats.

The unexpended balance, with such funds as may be appropriated by Congress, will be applied to carrying out the present project.

July 1, 1899, balance unexpended	$2,176.85
June 30, 1900, amount expended during fiscal year	245.79
July 1, 1900, balance unexpended	1,931.06
Amount (estimated) required for completion of existing project	32,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 1.)

2. *Harbor of refuge at Nantucket, Mass.*—This harbor is the only one between the harbor of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has a considerable area, with a depth of water in excess of 12 feet, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

The approved project of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal currents to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary to obtain a depth of from 12 to 15 feet at low water in this channel; all at a total cost estimated at $375,000, of which $220,000 was appropriated prior to 1896.

At the adoption of the present project no jetties existed and the channel entrance was barred by a shoal of 1.5 miles in width, on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

During an unusually severe storm in December, 1896, a breach was made through the Haulover Beach between the ocean and the head of the harbor. The breach still remains open, but it does not appear to have affected the depth of water in the entrance to the harbor.

The sum of $285,719.92 had been expended on this work up to June 30, 1899, of which $45,734.75 had been expended in ineffectual dredging between 1829 and 1844, and the balance, $239,985.17, in jetty construction, by which the west jetty had been built to 4,955 feet length, of which 3,955 feet was to full height and the remaining 1,000 feet had been built to the level of 1.5 feet below mean low water. The east jetty had been built to 834 feet length, with full height, then the foundation laid for a length of 191 feet, then came a gap of 160 feet, beyond which 1,300 feet length had been raised to half-tide level, and then

2,355 feet length raised to 1.5 feet below the level of mean low tide, the total length from shore end to outer end being now 4,840 feet. Mounds of heavy stone had been built near the present ends of the jetties to protect lantern staffs, and at intervals of 200 feet along the submerged portions smaller mounds had been built extending above high water.

A large portion of the 3,955 feet of the west jetty built prior to 1884 has been damaged somewhat by storms and ice, and, having no core of small stone, allows considerable sand to pass through it. This should be repaired so as to be as sand-tight as possible and raised to its original height. The estimated cost of such repairs is $30,000 in addition to the estimated cost of the project.

During the past fiscal year, under the approved project for the expenditure of the appropriation of March 3, 1899, the work of raising the outer portions of both jetties by contract was in progress, and 11,703 tons of stone was placed in the jetties, by which the submerged portions of the east jetty were raised to half-tide level, and 600 feet of the outer end of the west jetty was raised to full height and 400 feet to half-tide level. Eight feet of water at mean low tide can be carried into the harber.

Further work will consist in raising the incomplete portions of both jetties and extending the same.

The entire commerce of Nantucket Island is carried on at this harbor, amounting in 1899 to about 19,000 tons. The effect of this work will be to afford a place of refuge easy of access and secure from storms for coasters and fishing vessels.

July 1, 1899, balance unexpended		$20,014.83
June 30, 1900, amount expended during fiscal year		19,158.50
July 1, 1900, balance unexpended		856.33
July 1, 1900, outstanding liabilities		78.00
July 1, 1900, balance available		778.33
Amount (estimated) required for completion of existing project		115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1892, in addition to the balance available July 1, 1900:		
For works of improvement	$100,000.00	
For maintenance of improvement	15,000.00	
		115,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix D 2.)

3. Harbor at Vineyard Haven, Mass.—Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. The approved project of 1887, as modified in 1889, provides for the protection of the "chops" (or headlands) from erosion and the intervening harbor from being filled by the eroded material, the whole to be done by means of stone sea walls and jetties to be built along the beach in front of the bluffs at both headlands. The total cost was estimated in 1889 at $60,000, the whole of which has been appropriated.

At the adoption of the present project the headlands were gradually wearing away and the adjacent parts of the harbor were shoaling. No protection works were in existence.

The sum of $54,304.26 had been expended on this work up to June 30, 1899, by which there had been built a sea wall of 1,210 feet length and a jetty of 50 feet length and six small spurs extending back from the sea wall to the foot of the bluff at the East Chop, and at the West Chop a sea wall of 880 feet length, three jetties of 150, 135, and 280 feet length, a wharf, and a short breakwater of 60 feet length, and 2,400 feet length of riprap wall along the low-water line, and 13 short jetties running from the sea wall to the foot of the bluff, in front of the bluff on the east side of the West Chop. The works so far constructed appear to have afforded the needed protection.

During the past fiscal year no work of improvement was in progress. An examination of the harbor "with a view to its further protection and improvement as a harbor of refuge by a breakwater or otherwise" was made in September, 1899, and report thereon transmitted to Congress and printed in House Doc. No. 66, Fifty-sixth Congress, first session; it is also submitted herewith as Appendix D 23.

The unexpended balance will be applied to repairing existing works.

The commerce of the harbor in 1899 amounted to about 119,000 tons. The benefit to commerce of this work is the preservation of the anchorage area and harbor generally from shoaling.

July 1, 1899, balance unexpended	$5,695.74
July 1, 1900, balance unexpended	5,695.74

(See Appendix D 3.)

4. *Woods Hole Channel, Massachusetts.*—Woods Hole is a waterway or strait connecting Buzzards Bay and Vineyard Sound and lying near the southwestern part of Cape Cod, Massachusetts. The name is also applied to the village and harbor in the near vicinity.

Before improvement the entrance to Little Harbor was obstructed by a bar with but 7.5 feet on it at mean low tide. Great Harbor has ample depth. In the strait the channels were crooked and obstructed by bowlders, and the velocity of the currents at certain stages of the tide was from 5 to 7 miles per hour. The site of the wharves and basins of the United States Fish Commission and Revenue Marine Service was a submerged point of land extending from the shore of the harbor.

The project of 1879 provided for making a channel through the bar at the entrance to Little Harbor and widening and deepening the channel through the strait. The project of 1883, extended in 1884 and 1886, provided for the construction of retaining walls on shore, a stone pier, and a wooden wharf, mainly for the use of the United States Fish Commission, and incidentally for the use of the other branches of the public service, all of which work had been completed prior to 1889. The present approved project, that of 1895, provides for deepening the channel through the strait to 13 feet at mean low water and widening same to 300 feet, estimated to cost $396,000.

The amount expended on this work up to June 30, 1898, was $133,588.68, with which the entrance to Little Harbor had been dredged to 10 feet depth, and a direct channel to 9 feet depth had been dredged through the strait where none previously existed; the retaining walls, stone pier, and wooden wharves had also all been built and repaired; two cuts each 35 feet wide and 13 feet deep through the shoal at the eastern entrance to the channel had been made.

During the past fiscal year, under the approved project for the expenditure of the appropriation of March 3, 1899, the work of dredging and removing bowlders in the channel through the strait was in progress by contract, and 7,683 cubic yards of sand and small bowlders and 86.5 cubic yards of large bowlders were removed, removing all obstructing shoals to a depth of 13 feet at mean low water in the southern half of the channel, between its eastern end and the southern branch known as "Broadway." Thirteen feet of water at mean low tide can be carried through the eastern portion of the channel over a width of 150 feet.

Further work will consist of widening and deepening the channel through the strait.

The commerce of Woods Hole was about 17,000 tons for 1899, no account being kept of vessels passing through the strait. The deepening of this channel will result in more vessels using it than formerly.

July 1, 1899, balance unexpended	$20,011.24
June 30, 1900, amount unexpended during fiscal year	19,993.30
July 1, 1900, balance unexpended	17.94
July 1, 1900, outstanding liabilities	.20
July 1, 1900, balance available	17.74
Amount (estimated) required for completion of existing project	356,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	70,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 4.)

5. *New Bedford Harbor, Massachusetts.*—New Bedford Harbor is an estuary of Buzzards Bay, and is the port of the cities of New Bedford and Fairhaven.

Before improvement the channel had a depth of 12.5 feet at mean low water. The projects of 1874 and 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmers Island to the wharves of New Bedford. This work was completed in 1877 at a cost of $20,000.

The project of 1887 provided for a channel 200 feet wide and 18 feet deep from Buzzards Bay to New Bedford, at an estimated cost of $35,000, and has been completed.

The approved projects are those of 1895, providing for dredging an anchorage area one-half mile long, 600 feet wide, and 18 feet deep at mean low tide on the north side of the channel leading from Fairhaven to New Bedford, at an estimated cost of $57,689.33, and of 1899, providing for a channel 250 feet wide and 18 feet deep at mean low water from the anchorage basin through the new drawbridge between Fish and Popes islands to the deep water above, at an estimated cost of $34,000.

At the adoption of the present project the anchorage area was from 12 to 18 feet deep and the least depth in the channel between Fish and Popes islands was about 7.3 feet.

The sum of $82,647.50 had been expended on this work up to June 30, 1899, by which a channel 200 feet wide and 18 feet deep at mean low water had been secured from the deep water of Buzzards Bay to New Bedford and 11 acres of the anchorage area dredged.

During the fiscal year the work of dredging in the anchorage area and the new channel between Fish and Popes islands was in progress under two contracts. Work in the anchorage area resulted in the removal of 53,008 cubic yards of mud in the prolongation of the channel leading to the new drawbridge, connecting that channel with the main channel leading to Buzzards Bay and adding 7.4 acres to the dredged anchorage area. Dredging in the new channel between Fish and Popes islands resulted in the removal of 173,324 cubic yards of material and 11.8 cubic yards of large bowlders, completing the channel. Eighteen feet of water at mean low tide can be carried from the main channel through the new drawbridge and the 18-feet deep anchorage area was enlarged to 18.4 acres.

The work of dredging to be done is to complete the anchorage area and deepen the channel along the wharf front.

The tonnage of this harbor amounted to about 653,000 for 1899, which is an increase over the previous year. The effect of the deep water on commerce is the use of deeper draft vessels than formerly, larger cargoes, and a consequent reduction in water freight charges.

July 1, 1899, balance unexpended	$44,052.87
June 30, 1900, amount expended during fiscal year	44,045.91
July 1, 1900, balance unexpended	6.96
Amount (estimated) required for completion of existing project	37,689.33
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	37,700.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 5.)

6. *Taunton River, Massachusetts.*—This river rises in Norfolk County, Mass., and empties into Narragansett Bay at Fall River. The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, so that vessels of 11 feet draft can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was in places not more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879 $63,000 was appropriated to secure 9 feet depth at high water. This work was completed in 1879.

The approved project of 1880 provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley Bridge (above Dighton); thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal; thence 11 feet depth with 80 feet width up to the shipyard; thence 11 feet depth with 60 feet width up to Weir Bridge, Taunton; all at a total cost estimated in 1893 at $125,000, of which $118,000 was appropriated prior to 1899.

At the adoption of the present project the channel was limited to 9 feet at high water, and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

The sum of $180,510.11 had been expended on this work up to June 30, 1899, by which expenditure a large part of the proposed work had been done, especially at the places most complained of by vessels using this river. Vessels of 11 feet draft could reach Taunton, the head of navigation.

During the past fiscal year the work of dredging in the channel above Berkley Bridge was in progress, under contract, and 5,165 cubic yards of sand was removed, completing the reach above Berkley Bridge. A few troublesome bowlders below Burts Turn and at the upper end of the Needles were removed by hired labor.

Eleven feet depth of water can be carried at mean high water up to Taunton, but there are a few points below Berkley Bridge requiring widening and deepening.

The work done has enabled larger vessels to go up the river.

The tonnage of 1899 was about 579,000, showing an increase over previous years.

July 1, 1899, balance unexpended	$7,489.89
June 30, 1900, amount expended during fiscal year	7,489.70
July 1, 1900, balance unexpended	.19

(See Appendix D 6.)

7. *Sakonnet River, Rhode Island.*—Sakonnet River is an arm of the sea between the island of Rhode Island and the mainland, extending from the ocean to Mount Hope Bay around the head of Rhode Island. It is at present obstructed at its upper end by two causeways extending across it; these causeways have draw openings, which are of insufficient width and depth for the needs of commerce, and besides offer such obstruction to the ebb and flow of the tides that the currents through them make the passage dangerous even to boats of such dimensions as could pass through them under ordinary circumstances.

The present approved project provides for increasing the width and depth of the draw opening in the Stone Bridge, owned by the State of Rhode Island, so as to provide an opening 100 feet wide and 25 feet deep at mean low water, estimated to cost $40,000.

No work has been done and no funds expended, owing to the fact that the State assembly's permission to the United States to widen and deepen the draw opening in its bridge is conditioned in such a way as to make it inoperative until the railroad company shall have widened and deepened the draw opening in its bridge, and to the further fact that the proposed work involves the total destruction of the present bridge and existing highway, while no provision is made for rebuilding the bridge or restoring the highway. Until the State of Rhode Island grants the Federal Government the unconditional right to proceed with the work authorized by Congress, and provides either for the restoration or discontinuance of the bridge and highway, the Secretary of War can not proceed with the work. The authorities of the State have been repeatedly advised of the existing complications, and of the importance of having the legislature take the proper action to remove them.

The New York, New Haven and Hartford Railroad Company was notified by the Secretary of War to construct a suitable draw in its bridge by May 1, 1899. The time for completing the new draw in the railroad bridge was subsequently extended to May 1, 1900, and later to May 1, 1901. The railroad company commenced work during the past year; the piers, abutments, etc., have been built, and work of placing the steel work commenced.

The tonnage of the river for the year 1899 amounted to about 12,000.

July 1, 1899, balance unexpended	$40,000.00
July 1, 1900, balance unexpended	40,000.00

(See Appendix D 7.)

8. *Sakonnet Point, Rhode Island.*—This is a new work. Sakonnet Point is a rocky headland, on the eastern side of the mouth of Sakonnet River, and lies about 6 miles east of Newport.

Sakonnet Point, in connection with Churchs Cove, just north of it, forms an anchorage protected from the southeast to northeast, but exposed to storms from the south to the northwest.

About the year 1827 a breakwater about 200 feet long was built, but it has washed down to a considerable extent.

The present project, that of 1897, approved by the river and harbor act of March 3, 1899, provides for prolonging this old breakwater out to a rock just north of it and raising the whole to a height of 8 feet above mean low water, at an estimated cost of $25,000, which has been appropriated.

During the past fiscal year, under the approved project for the expenditure of the appropriation of March 3, 1899, the work of constructing a breakwater was in progress under contract. Up to the close of the fiscal year 16,745 tons of stone had been placed in the work and the contract nearly completed. About 486 tons of stone, which had been washed from the old breakwater into the harbor, were recovered and placed in the new breakwater.

Further work will consist in completing the breakwater. The work already done affords good shelter to the landing in Churchs Cove.

The commerce of this place is as stated under the Sakonnet River.

The rebuilding and extension of the breakwater will afford a harbor of refuge for the large number of fishing craft frequenting the neighborhood.

July 1, 1899, balance unexpended		$25, 000. 00
June 30, 1900, amount expended during fiscal year		14, 721. 21
July 1, 1900, balance unexpended		10, 278. 79
July 1, 1900, outstanding liabilities	$6, 283. 84	
July 1, 1900, amount covered by uncompleted contracts	2, 647. 03	
		8, 930. 87
July 1, 1900, balance available		1, 347. 92

(See Appendix D 8.)

9. *Pawtucket River, Rhode Island.*—This river, otherwise called Seekonk River, is the upper portion of Providence River, and extends from Pawtucket to Providence. Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1873, $52,000 was appropriated to dredge the channel to 7 feet depth. This work was finished in 1876.

The approved project of 1883 provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water, with 100 feet width from its mouth, at Providence, up to opposite Grant & Co.'s wharf at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance farther to Pawtucket Bridge; all at a total cost estimated in 1883 at $382,500, of which $205,000 was appropriated prior to 1895.

The river and harbor act of March 3, 1899, provides for straightening that portion of the channel between Ten-mile River and Bucklins Island; and the available balance, together with the further funds provided by Congress, will be applied to this work and to deepening the channel at points where it has shoaled.

At the adoption of the present project the channel was narrow and only about 5 feet deep.

The sum of $266,984.34 had been expended on this work up to June 30, 1899, by which a channel had been secured 100 feet in width and 12 feet in depth from the mouth of the river, near Providence, up to the lower wharves of the city of Pawtucket; thence a channel of 40 feet width and 12 feet depth had been completed through the ledge rock to the head of navigation.

During the fiscal year a survey was made with a view to straightening the channel between Red Bridge and Ten-mile River, and between Bucklins Island and Pawtucket Bridge; the report of results was transmitted to Congress and printed in House Doc. No. 113, Fifty-sixth Congress, first session, and is also submitted herewith as Appendix D 28. Dredging under the 1899 appropriation was commenced and continued under contract on the new work between Ten-mile River and Bucklins Island, and 108,838 cubic yards of material was removed. The present available depth at mean low water is about 12 feet.

The effect of the improvement is to cause the use of vessels of deeper draft than formerly, larger cargoes, and cheaper rates. The completed portion of the channel has already been a great benefit to the commerce of the river, which in 1899 amounted to a tonnage of about 213,000.

The work yet to be done is to straighten and deepen the channel in its lower portions.

July 1, 1899, balance unexpended		$40,535.25
June 30, 1900, amount expended during fiscal year		15,187.62
July 1, 1900, balance unexpended		25,347.63
July 1, 1900, outstanding liabilities	$3,224.30	
July 1, 1900, amount covered by uncompleted contracts	20,810.33	
		24,034.63
July 1, 1900, balance available		1,313.00

Amount (estimated) required for completion of existing project	28,580.35
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	28,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 9.)

10. Providence River and Narragansett Bay, Rhode Island.—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation and at one point in the channel, a place called "The Crook," the available low-water depth was but 4.5 feet. Between 1852 and 1873 $59,000 was appropriated to secure first 9 and then 12 feet depth of channel. This work was finished in 1873.

The approved project of 1878, as modified in 1882, provides for deepening the river and deepening and widening its anchorage basins, so as to secure a channel of at least 25 feet depth at low water with 300 feet width from the deep water of Narragansett Bay up to Providence, R. I., and so as to secure anchorage basins of 20 feet depth with 600 feet width, 18 feet depth with 725 feet width, 12 feet depth with 940 feet width, and 6 feet depth with 1,060 feet width from Fox Point to Field Point; all at a total cost estimated in 1882 at $675,000.

At the adoption of this project the channel was limited to 12-foot depths and the anchorage areas were much too small and shallow for the craft seeking them.

The river and harbor act of June 3, 1896, provided for securing a ship channel 400 feet in width and of a depth of 25 feet at mean low water from Sassafras Point, in Providence Harbor, through Providence River and Narragansett Bay by the most direct route practicable to the ocean, by way of the "Western Passage," so called, at an estimated cost of $732,820.

The item in the act is as follows:

> Improving Providence River and Narragansett Bay, Rhode Island: Continuing improvement, according to the report of the Chief of Engineers, dated April ninth, eighteen hundred and ninety-six, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and seven thousand dollars, exclusive of the amount herein and heretofore appropriated.

The sum of $831,554.81 had been expended on this work up to June 30, 1899, by which Bulkhead Rock had been removed and the channel 300 feet wide and 25 feet deep had been secured to the city of Providence and an anchorage area 1,060 feet wide, with depths varying from 6 to 20 feet, had been dredged, but both the channel and the anchorage area now need some redredging. One million one hundred and thirty-six thousand nine hundred and fifty-one cubic yards of material was removed from the channel in widening it to 400 feet from Sassafras Point south to Conimicut Light-House, the depth being 25 feet.

During the past fiscal year dredging has been in progress under the continuous contract for continuing the 400-foot ship channel below Conimicut Light-House through the Western Passage of Narragansett Bay, and 389,677 cubic yards of material was removed.

The available unexpended balance will be applied to continuing the dredging in the new ship channel.

The improvement has been of great benefit to commerce, which in 1899 amounted to about 2,823,000 tons, an increase over past years.

July 1, 1899, balance unexpended		$145, 088. 58
Amount appropriated by sundry civil act approved June 6, 1900		54, 489. 00
		199, 577. 58
June 30, 1900, amount expended during fiscal year		61, 468. 98
July 1, 1900, balance unexpended		138, 108. 60
July 1, 1900, outstanding liabilities	$7, 364. 83	
July 1, 1900, amount covered by uncompleted contracts	165, 850. 26	
		173, 215. 09
Amount (estimated) required for completion of existing project		59, 984. 03
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		59, 984. 03
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix D 10.)

11. Removal of Green Jacket Shoal, Providence, R. I.—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves, on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves, and about 30 acres in all.

The approved project of 1885 provides for the removal, to 25 feet depth at low water, of a middle-ground shoal of about 30 acres area in

Providence River, opposite the city, the portion to be removed to be at least 200 feet distant from the harbor lines of the city; all at a total cost estimated in 1885 at $112,346.

At the adoption of the present project the shoal in many places carried only 1 foot of water and was a very troublesome obstruction.

The sum of $103,917.74 had been expended on this work up to June 30, 1899, by which 23.8 acres out of the original 30 of this shoal had been dredged to 25 feet depth, and a 16-foot depth had been secured over the central and largest portion of the shoal in addition to a 20-foot depth in the main channel, making an important addition to the anchorage facilities of Providence Harbor.

No work was in progress during the year, as no funds were appropriated by the 1899 river and harbor act.

The removal of this shoal will enable vessels to anchor outside of the channel, and thus remove an obstruction to vessels going to or from the Providence wharves.

Further funds will be applied to extending the area of 25 feet depth.

July 1, 1899, balance unexpended	$332.26
July 1, 1900, balance unexpended	332.26

Amount (estimated) required for completion of existing project	8,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 11.)

12. Harbor at Wickford, R. I.—Wickford Harbor is an arm of Narragansett Bay, about 18 miles south of Providence and 12 miles northwest of Newport. It is the water terminus of the Wickford Railroad, which connects with the New York, New Haven and Hartford Railroad at Wickford Junction, and in conjunction with a ferry route from Wickford to Newport forms the shortest line of communication between Newport and New York and other points west.

The present approved project of 1896 provides for the removal of certain bowlders and deepening the harbor by dredging.

The sum of $15,563.89 had been expended on this improvement up to June 30, 1899, which removed some of the bowlders from the entrance to the harbor and gave a channel 60 feet wide and 9 feet deep at mean low water, with enlargements at the bends up to the wharves in Wickford.

During the past fiscal year the few bowlders remaining at the entrance to the harbor were removed by a diver and the use of a hired steam lighter, exhausting all funds and completing all work under the present project.

The tonnage of this harbor for 1899 amounted to about 21,000, an increase over former years.

July 1, 1899, balance unexpended	$736.11
June 30, 1900, amount expended during fiscal year	736.11

(See Appendix D 12.)

13. Fall River Harbor, Massachusetts.—Fall River Harbor lies at the mouth of Taunton River in the northeastern angle of Mount Hope Bay, which empties into the ocean through Narragansett Bay and Sakonnet River. It forms the port of entry of the city of Fall River, the largest cotton manufacturing city in the United States.

Before improvement, the reentrant in the wharf line north of the Old Colony Steamboat Company's wharf was limited to about 6 feet depth of water, and a considerable area of the harbor, especially in front of the upper wharves, carried much less depth of water than existed in its approaches.

The project of 1874 provided for deepening an area in front of the wharves immediately north of the Old Colony Steamboat Company's wharf 160 feet wide to 12 feet, and an additional width of 100 feet to 11 feet at mean low tide. This improvement was completed in 1878 with an expenditure of $30,000.

No additional funds had been expended on this harbor up to June 30, 1899.

The present plan of improvement, that of 1897, approved by the river and harbor act of March 3, 1899, provides for a channel 300 feet wide and 25 feet deep at mean low tide along the city front between the Old Colony Wharf and deep water at the upper end of the city front, at an estimated cost of $58,060.47.

At the adoption of the present project the proposed new channel had a minimum depth of about 14 feet.

During the past fiscal year the work of dredging in the new channel in front of the city wharves was in progress under contract and 193,579 cubic yards of mud and sand was removed, completing the lower reach of the channel to full width and depth. A map of the proposed harbor line was submitted and approved. The marking stones, etc., for fixing the line have been put down, and the plotting of same on map and description of line and marks is in course of preparation.

The work required to complete the existing project is dredging the upper portion of the new channel.

The commerce of the port in 1899 amounted to about 3,220,000 tons, and the proposed improvement will give increased facilities for deeper draft vessels.

July 1, 1899, balance unexpended	$20,000.00
June 30, 1900, amount expended during fiscal year	19,997.40
July 1, 1900, balance unexpended	2.60
Amount (estimated) required for completion of existing project	38,060.47
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	38,000.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 13.)

14. Newport Harbor, Rhode Island.—This harbor is at the main entrance to Narragansett Bay, and all the year it serves as an easily accessible harbor of refuge to foreign and coastwise commerce.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the northern entrance by a sharp rocky spit near Rose Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875 $28,500 was appropriated to secure 12 feet depth in the harbor. This work was completed in 1876.

The approved project of 1880, as modified in 1882, 1883, 1884, 1890, and 1895, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water, with at least 750 feet width; for the extension of the 13-foot depth and 10-foot depth anchorage basins; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island so as to protect the end of this island from erosion and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor; and for the removal of Spindle Rock, a sharp rocky spit near Rose Island; all at a total cost estimated in 1895 at $206,200.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area was too small for the craft seeking harborage at this place during the summer and all the year during storms.

The sum of $180,609.13 had been expended on this work up to June 30, 1899, by which the 15-foot channels and 13-foot anchorage basins had been completed, the shoal spit at the southern end of Goat Island had been cut off, and one jetty 133 feet long had been built westward from Goat Island. The southern entrance had been completed for vessels of 15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about 75.25 acres had been completed, and 409.14 cubic yards of rock had been removed from Spindle Rock, securing a depth of 8.5 feet at low water over the remaining portion of the rock.

During the past fiscal year work of dredging a small area near the dolphin at the southern end of Goat Island and in the 10-foot anchorage area was in progress under contract, and 97,833 cubic yards of material and 14.51 cubic yards of large bowlders were removed, completing the area near the dolphin and the 10-foot anchorage area.

The work required to complete the existing project is the clearing up of certain shoal places in the harbor proper, also the building of additional jetties outside of Goat Island, whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

As the improvement of this harbor has progressed there has been a large increase in the size and number of vessels using the harbor. The commerce for 1899 shows a tonnage of about 462,000, principally fish, coal, and general merchandise.

July 1, 1899, balance unexpended	$14,899.39
June 30, 1900, amount expended during fiscal year	14,709.50
July 1, 1900, balance unexpended	189.89
July 1, 1900, outstanding liabilities	180.53
July 1, 1900, balance available	9.36
Amount (estimated) required for completion of existing project	39,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	39,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 14.)

15. Harbor of refuge at Point Judith, Rhode Island.—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction, about 1.5 miles west of the point.

The approved project of 1889 provides for the construction at this point of a national harbor of refuge nearly a mile square, by means of stone breakwaters built partly on Squid Ledge and planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north, all at a total cost estimated in 1889 at $1,250,000, all of which has been appropriated.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project, on the basis of the above estimated total cost, the work to be paid for as appropriations should from time to time be made by law.

At the adoption of the project this point was a specially dangerous place for boats and tows to pass during storms and even ordinarily bad weather.

The sum of $1,242,288.19 had been expended on this work up to June 30, 1899, by which the breakwater had been built to a total length of 6,970 feet, with a height of 10 feet above mean low water; width on top, 20 feet; sea slope of 1 on 2 to a depth of 12 feet below low water, and thence a slope of 1 on 1, and a harbor slope of 1 on 1. It incloses an area of about 1 square mile with 12 feet of water, and about 0.92 of a mile with 18 feet of water, more than two-thirds of which is over 25 feet deep. Three beacon lights had been established and maintained on the breakwater.

During the past fiscal year no operations were in progress, but 3 small lights were maintained. The harbor slopes of the breakwater were slightly damaged during a severe storm occurring on March 2 and 3, 1899.

The limit of cost of this improvement, as fixed by law, was based on an estimate prepared in 1889 from the best information then available. Experience and additional information gained since that time show that to secure all the beneficial results designed to be accomplished by the breakwater and to properly strengthen and extend it, further appropriations are necessary.

The total amount of the original estimated cost having been appropriated, an estimate of $444,310.98 is submitted as the additional sum that will be required to strengthen the breakwater and make the necessary additions to it, as recommended by a Board of Engineers in report of October 23, 1896. (See Annual Report of the Chief of Engineers for 1897, p. 920.)

It is proposed to apply the balance available to maintenance of lights and repair of the breakwater.

Further work is dependent upon additional appropriations. Three hundred and fourteen vessels of all classes sought refuge in the protected harbor during the year ending December 31, 1899.

July 1, 1899, balance unexpended	$7,750.42
June 30, 1900, amount expended during fiscal year	1,338.76
July 1, 1900, balance unexpended	6,411.66
July 1, 1900, outstanding liabilities	121.26
July 1, 1900, balance available	6,290.40
Amount (estimated) required for completion of existing project	444,310.98
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 15.)

16. Entrance to Point Judith Pond, Rhode Island.—Point Judith Pond is a shallow-draft salt pond, lying in rear of the sandy beach of the Rhode Island shore, just west of Point Judith.

The improvement desired at this place by the people of the neighborhood is the reopening of an old entrance long ago closed by the ocean storms.

The present entrance to this pond is very shallow (less than 3 feet), crooked, and variable in location, and lies about a mile west of the former entrance.

There is at present no approved project for the improvement of this pond entrance.

Up to June 30, 1899, $518.38 had been expended in surveys.

July 1, 1899, balance unexpended	$9,481.62
July 1, 1900, balance unexpended	9,481.62

(See Appendix D 16.)

17. Harbor of refuge at Block Island, Rhode Island.—This island is about 14 miles east of the eastern end of Long Island, and about 10 miles distant from the nearest point of the mainland.

The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels.

Between 1870 and 1876 $285,000 was appropriated for a breakwater for a harbor for medium-draft vessels, this work being completed in 1878. Between 1880 and 1882 $25,000 was appropriated for dredging an inner basin and the protection of the shore next the breakwater, this work being completed in 1884. In 1884, $15,000 was appropriated for additions to the old breakwater, this money being so spent and work completed in 1884–85.

The approved project of 1884, as modified in 1888, provided for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) 800 feet square for small vessels and an exterior harbor for larger ones, at a total cost estimated in 1888 at $75,000. This project was practically completed in 1893.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 18, 1894, provides for raising the entire breakwater to proper height and stopping sand leaks between certain points and dredging the main inner harbor to a depth of 10 feet, at an estimated cost of $83,985.

At the adoption of the present project this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

The sum of $404,487.73 had been expended on this work up to June 30, 1899, and under the project of 1888 the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the sea walls of the inner harbor had been completed (except as to stone fender piers at the entrance); wooden fender piers had been built for present uses; the worst rocks and bowlders had been removed from the new inner harbor; the shoal west of the breakwater had been dredged to a depth of 9 feet from the steamboat wharf to within 100 feet of the north wall, and the entrance to the inner harbor, which had shoaled up from the drift of sand through the main breakwater, had been partially dredged to a depth of 12 feet and redredged to 10 feet depth three times.

During the past fiscal year a contract was entered into for strengthening and repairing the north wall of the inner harbor, and 2,901.73 tons of stone was put in place. A contract was also entered into for dredging the shoal at the entrance to the inner harbor, and 5,500 cubic yards was removed, giving a depth of 10 feet of water at mean low tide.

It is estimated that $2,500 will be required each year, until the main breakwater is made sand tight, to dredge the entrance to inner harbor.

Additional funds, if provided, will be applied to repairing the main breakwater, making it sand tight in certain parts, and to dredging the inner harbor.

The increase of depth at entrance has enabled a larger class of vessels to use the harbor, and since the completion of the breakwater a greater number of vessels use the harbor for refuge. In 1899 the commerce amounted to about 55,000 tons, an increase over previous years.

July 1, 1899, balance unexpended	$12,012.27
June 30, 1900, amount expended during fiscal year	8,088.38
July 1, 1900, balance unexpended	3,923.89
July 1, 1900, outstanding liabilities	1,790.56
July 1, 1900, balance available	2,133.33
Amount (estimated) required for completion of existing project	78,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 17.)

18. Great Salt Pond, Block Island, Rhode Island.—The Great Salt Pond is located about the center of Block Island and contains an anchorage area of 150 acres for vessels drawing 18 feet and over. The work of converting the pond into a harbor of refuge by making a channel through the beach on the west, connecting it with deep water in the ocean, was started by the State of Rhode Island and the town of New Shoreham.

The channel, under the approved project of 1895, is to be 600 feet wide and to have a central depth of 25 feet for a width of 150 feet, sloping gradually to 12 feet in a width of 504 feet, the channel seaward to be protected on the south by a jetty extending to the 18-foot contour and on the north by a jetty about 500 feet long.

At the time work commenced under the General Government a channel of varying width and depth had been dredged with the money appropriated by the State and town, which would permit of 12-foot draft being carried in, although there were two 9-foot spots left in mid-channel. The south jetty had been built out 837 feet and a north jetty 250 feet long had also been built, but at a distance of 720 feet from the south jetty instead of 600 feet, as called for in the adopted project.

Up to June 30, 1899, the work under Congressional appropriations was as follows: The south jetty had been extended over 400 feet, or to about 19 feet of water, and some dredging had been done in main channel, to wit, 10,756 cubic yards. Under date of June 15, 1900, a modified project was approved, extending the south jetty 350 feet and building a north jetty 600 feet from it and about 1,200 long, at a cost of $215,000 in addition to what has alreadv, been appropriated.

Up to June 30, 1899, $39,927.77 had been expended on this work.

During the past fiscal year dredging was in progress under contract to make a channel 300 feet wide and 18 feet deep, to be completed by October 1, 1900; some repairs were made to the south jetty.

There is at present a channel of navigable width, 18 feet deep at low water.

There remains to complete the existing project the construction of jetties as planned and dredging to secure the width and depths projected.

July 1, 1899, balance unexpended		$50,072.23
June 30, 1900, amount expended during fiscal year		11,184.24
July 1, 1900, balance unexpended		38,887.99
July 1, 1900, outstanding liabilities	$5,632.09	
July 1, 1900, amount covered by uncompleted contracts	13,715.05	
		19,347.14
July 1, 1900, balance available		19,540.85
Amount (estimated) required for completion of existing project		215,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 18.)

19. Removing sunken vessels or craft obstructing or endangering navigation—Schooners Lunet, Hector, J. D. Ingraham, Nellie Doe, and E. C. Willard.—All these vessels were wrecked during the storm of November, 1898; the *Lunet* was sunk in 7 fathoms of water about one-half mile southeast of the black buoy at Tarpaulin Cove, and the others were sunk in Vineyard Haven Harbor. The *Lunet*, *Hector*, and *Willard* were completely destroyed during January and February, but the schooners *J. D. Ingraham* and *Nellie Doe* were not removed by the Government force and plant, as they were taken in charge and transferred to a point near the marine railway by a resident of Vineyard Haven who stated that he had purchased them.

The cost of work on wrecks during the year was $1,898.26.

(See Appendix D 19.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the act of March 3, 1899, were made by the local officer, Maj. D. W. Lockwood, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. G. L. Gillespie, Corps of Engineers:

1. Preliminary examination of Bass River Harbor, Massachusetts.—Major Lockwood submitted report dated August 18, 1899. In his opinion the locality is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 142, Fifty-sixth Congress, first session. (See also Appendix D 20.)

2. *Preliminary examination and survey of harbor at Hyannis, Mass.*—Major Lockwood submitted reports dated August 19 and November 27, 1899. He considers the locality worthy of improvement and presents plan to the extent of completing the existing project at an estimated cost of $32,500. The report was transmitted to Congress and printed in House Doc. No. 79, Fifty-sixth Congress, first session. (See also Appendix D 21.)

3. *Preliminary examination of Cotuit Harbor, Massachusetts.*—Major Lockwood submitted report dated August 19, 1899. He considers the locality to be not worthy of improvement by the General Government, and his opinion is concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 167, Fifty-sixth Congress, first session. (See also Appendix D 22.)

4. *Preliminary examination of Vineyard Haven, Massachusetts, with a view to its further protection and improvement as a harbor of refuge by a breakwater or otherwise.*—Major Lockwood submitted report dated September 13, 1899, and stated that he was not prepared to state definitely that the locality is worthy of improvement, but expressed the opinion that there is great need for some safe harbor for vessels passing through Vineyard Haven and Nantucket sounds. I recommended that no survey of the locality be made, but suggested that the report be submitted to Congress with recommendation that the subject should receive consideration by a Board of Engineers with a view to the selection of a site. The report was transmitted to Congress and printed in House Doc. No. 66, Fifty-sixth Congress, first session. (See also Appendix D 23.)

5. *Preliminary examination at Cottage City, Mass.*—Major Lockwood submitted report dated August 22, 1899. In his opinion the locality is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 140, Fifty-sixth Congress, first session. (See also Appendix D 24.)

6. *Preliminary examination and survey of New Bedford Harbor, Massachusetts.*—Major Lockwood submitted reports dated June 24 and November 17, 1899, respectively. The project presented contemplates improvement above and below the new drawbridge between Fish and Popes islands, by dredging, at an estimated cost of $11,000. The reports were transmitted to Congress and printed in House Doc. No. 169, Fifty-sixth Congress, first session. (See also Appendix D 25.)

7. *Preliminary examination of Westport Point Harbor, Massachusetts.*—Major Lockwood submitted report dated September 11, 1899. In his opinion the locality is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 68, Fifty-sixth Congress, first session. (See also Appendix D 26.)

8. *Preliminary examination of channel of Assonet River, Massachusetts.*—Major Lockwood submitted report dated August 10, 1899. In his opinion the locality is not worthy of improvement by the General Government, and his opinion is concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 102, Fifty-sixth Congress, first session. (See also Appendix D 27.)

9. *Preliminary examination and survey of Pawtucket River, Rhode Island.*—Major Lockwood submitted reports dated August 29 and November 25, 1899, respectively. He presents a project for improvement above Red Bridge at an estimated cost of $237,875, but states that he does not feel justified in recommending an increase in depth of the channel of this river while the condition of affairs remains as at present at the railroad bridge at India Point, although $410,000 could be expended advantageously in cleaning out the present channel to its full width of 100 feet for 12 feet depth. In forwarding the report on survey the division engineer states that the bridge at India Point is an unreasonable obstruction to navigation, and he recommends that no further appropriation be made for the improvement of the river from this bridge to Pawtucket until the bridge shall have been reconstructed to meet the demands of the commerce of the upper reach of the river. The reports were transmitted to Congress and printed in House Doc. No. 113, Fifty-sixth Congress, first session. (See also Appendix D 28.)

10. *Preliminary examination and survey of Providence Harbor and River, Rhode Island.*—Major Lockwood submitted reports dated June 13 and November 11, 1899. Two plans for improvement are presented estimated to cost $724,856 and $607,777.50, respectively, the latter being considered the better one. The reports were transmitted to Congress and printed in House Doc. No. 108, Fifty-sixth Congress, first session. (See also Appendix D 29.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Ohio Reef, located in the east passage of Narragansett Bay, Rhode Island, with a view to determining the advisability of removing said reef as a dangerous obstruction to the navigation of said bay.*
2. *Sakonnet Harbor, Rhode Island, to ascertain the advisability and cost of removing rocks which are an obstruction to navigation.*
3. *Pawtucket River, Rhode Island, with a view to securing a channel 200 feet wide and 18 feet deep from the mouth of the river at Providence to the lower wharves in the city of Pawtucket.*

IMPROVEMENT OF RIVERS AND HARBORS IN CONNECTICUT, AND OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

This district was in the charge of Maj. Smith S. Leach, Corps of Engineers, having under his immediate orders Lieut. William J. Barden, Corps of Engineers, to October 20, 1899, and Lieut. Edward H. Schulz, Corps of Engineers, since October 19, 1899. Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

1. *Pawcatuck River, Rhode Island and Connecticut.*—The navigable part of the Pawcatuck River extends 5 miles from the town of Westerly, R. I., to its outlet in Little Narragansett Bay; thence the navigable channel extends through Little Narragansett Bay 2¼ miles to Stonington outer harbor, which forms the approach to the bay and

river. Little Narragansett Bay is about 1½ miles wide and 2½ miles long, and is separated from the ocean by a sand beach. Its outlet into Stonington Harbor is about three-fifths of a mile wide. Pawcatuck River has a width of about one-third of a mile at its mouth and diminishes to 200 feet at Westerly; its average width is 1,000 feet. The object of the improvement is to deepen and widen the channel of the river and Little Narragansett Bay from Westerly to Stonington Harbor, a total distance of 7½ miles. The improvement previous to 1884 was carried on under two projects, one for Pawcatuck River and the other for Little Narragansett Bay, but now it is all included in the project for improvement of Pawcatuck River. (For maps see Annual Report of the Chief of Engineers for 1879, p. 314; for 1885, p. 624, and House Doc. No. 62, Fifty-fourth Congress, first session.)

Before improvement the channel of the river was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water, and 4½ feet was the greatest depth that could be carried across the shoals of the bay. The mean tidal oscillation is 2.6 feet at the mouth of the river and 2.3 feet at Westerly. Between 1871 and 1876 $50,000 was appropriated for the excavation of a channel in the river 5½ feet deep at mean low water, 75 feet wide below the wharves, and from 35 to 40 feet wide between the upper and lower wharves at Westerly. Between 1876 and 1883 $36,000 was appropriated for making a channel through the bay 200 feet wide and 7½ feet deep at mean low water by dredging and the removal of rocks from the bay, and between 1885 and 1895 $48,400 was appropriated for increasing the depth and width in the river to a low-water depth of 8 feet with width of 100 feet below the wharves and 40 feet opposite the wharves at Westerly. The three projects have been completed as designed—the first in 1876, the second in 1884, and the third in 1895.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 18, 1894, provides for a channel of 10 feet depth at mean low water from Stoningtor to Westerly, with a width of 200 feet from Stonington, Conn., to Avondale, R. I., a distance of about 4 miles; a width of 100 feet from Avondale to the lower wharves of Westerly, a distance of about 3 miles; and a width of 40 feet between the upper and lower wharves at Westerly, a distance of about one-half mile, at a total estimated cost of $200,361.60.

The sum of $148,776.32 had been expended up to June 30, 1899, by which the 8-foot channel had been completed under previous projects from Stonington to Westerly, and under the new 10-foot project the 40-foot channel opposite the wharves at Westerly and 1,800 linear feet of the 100-foot channel below the wharves had been completed to the projected depth of 10 feet by the removal of ledge rock and bowlders and by dredging.

During the fiscal year ending June 30, 1900, the appropriation of March 3, 1899, was applied to the project by dredging, under contract; 43,797 cubic yards was removed, completing the projected 10-foot channel for a distance of 3,600 feet, to a point 7,900 feet below the upper end. The estimate submitted for fiscal year ending June 30, 1902, contemplates extending the channel downstream.

No work having been done at the lower end under the new project, 8 feet at mean low water was the maximum draft that could be carried from Stonington to Westerly at the close of work, and it is believed that no shoaling has occurred since that time.

The effects of the improvement are the use of a larger class of vessels than formerly, larger cargoes, and cheaper freights on them.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	1,285	2 to 8	3 to 300	28,667		
1893	2,045	5 to 10	3 to 300	35,968	7,301	
1894	1,774	5 to 10	3 to 300	52,805	16,837	
1895	1,824	2 to 10	3 to 800	43,671		9,134
1896	5,009	2 to 10	3 to 800	39,086		4,585
1897	5,008	2 to 10	3 to 800	46,024	6,938	
1898	4,469	2 to 8	3 to 200	131,602	85,578	
1899	4,405	2 to 8	3 to 200	66,742		64,860

The reported value of this commerce for 1899 was $355,282.48.

One new transportation company was established during the year, but has been discontinued.

July 1, 1899, balance unexpended	$15,223.69
June 30, 1900, amount expended during fiscal year	15,129.53
July 1, 1900, balance unexpended	94.16
Amount (estimated) required for completion of existing project	170,361.60
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 1.)

2. *Harbor of refuge at Stonington, Conn.*—Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and its breakwaters are for the purpose of making a harbor of refuge for vessels entering and leaving this entrance. Stonington Harbor originally was an open bay, unprotected from southerly storms and obstructed by a shoal having a low-water depth of about 6 feet at the shoalest part. The mean tidal oscillation is 2.7 feet. (For maps see Annual Report of the Chief of Engineers for 1882, p. 598, p. 632 of 1884, p. 848 of 1893, and for further information p. 585 of 1881.) Between 1827 and 1831 about $37,000 was spent in constructing piers or breakwaters in the inner harbor for the protection of the general anchorage (Annual Report of the Chief of Engineers for 1879, p. 326). In 1871 a survey of the harbor was provided for, and in 1873 an appropriation was made for dredging the harbor to 12 feet depth, this work being finished in 1875 (Annual Report of the Chief of Engineers for 1874, p. 247). Between 1875 and 1879 $102,500 was appropriated for the construction of a western breakwater about 2,000 feet long, extending to 18 feet depth of water, and for dredging the harbor to 12 feet depth inside this breakwater, this work being completed in 1880.

The approved project of 1880 provides for the construction of an eastern breakwater as a protection to the outer harbor, this breakwater, about half a mile long, to extend from the vicinity of Bartletts Reef to the vicinity of the Middle Ground Shoal, or until it gives sufficient protection to the harbor against southerly winds, all at a total cost (estimated in 1884) of from $143,000 to $191,000, according to length. This did not include the cost of a light-house foundation on the western end of the structure. The positions of the ends of this breakwater have not been definitely determined.

At the adoption of the present project, that of 1880, the outer harbor had no eastern breakwater.

To June 30, 1899, $147,799.04 had been expended on the present project, with its subsequent additions, completing 2,900 linear feet of the eastern breakwater, at a cost of $143,011.85, and under an addition to the project in 1884 a cut across Noyes Shoal, 160 feet wide and 17 feet deep at mean low water, had cost $4,187.22, and under an addition to the project in 1896 a dike or water break around Stonington Point had cost $3,352.77. The sum of $184,408.83 had been expended on previous projects, including the western breakwater and dredging at the entrance of the harbor, making the aggregate expended to that date under projects for Stonington Harbor $336,395.09. The deepening of the harbor has brought about a large increase in commerce, and the construction of breakwaters affords a harbor of refuge for vessels of all kinds in the inner and outer harbors, which is extensively used as such. The maximum draft that could be carried to the docks, at time of last survey, in 1895, was the project depth of 12 feet at mean low water, and as far as known that depth still exists.

During the fiscal year a light was maintained on the unfinished breakwater. Nothing in furtherance of the project was done.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure, together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1891	6,300	2¼ to 12	4 to 1,500	274,014		
1892	4,018	3 to 12	30 to 1,500	300,000	25,986	
1893	3,201	3 to 12	30 to 1,500	305,750	5,750	
1894	3,201	3 to 12	30 to 1,500	299,870		5,880
1895	3,950	3 to 12	20 to 1,500	322,814	22,944	
1896	4,265	2¼ to 12	7 to 1,500	349,650	26,836	
1898	3,465	2¼ to 12	25 to 1,500	345,500		4,150
1899	3,465	2¼ to 12	25 to 1,500	489,000	143,500	

The estimated value of this commerce for 1899 is $84,984,125.
No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended	$1,058.74
June 30, 1900, amount expended during fiscal year	484.95
July 1, 1900, balance unexpended	573.79

(See Appendix E 2.)

3. *Mystic River, Connecticut.*—Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut. The navigable part of the river extends in a general northeasterly direction for nearly 4 miles from Fishers Island Sound, past the villages of Noank, West

Mystic, and Mystic, above which places it receives the discharge oi several small fresh-water streams. The village of Mystic lies on both the east and west banks of the river, about 3 miles above Fishers Island Sound. At this point the river is crossed by a highway bridge with a draw. Nearly a half mile farther down is the drawbridge of the New Nork, New Haven and Hartford Railroad.

Directly opposite the mouth of the river lie Mystic, or Ram, Island and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but crooked; it is the one used by large vessels. The southwest channel opens out into a broad flat, with about 12 feet available depth.

The river channel up to within a half mile below the highway bridge had a natural low-water depth of 15 feet or more, shoaling to about 10½ feet near the bridge, where the channel was very narrow. Its width in the lower part (from 80 to 300 feet) was sufficient, but there were several bends in its course, which made it somewhat difficult of navigation. A sketch of Mystic River was printed in the Annual Report of the Chief of Engineers for 1893, page 898.

The mean rise of tide is 2¼ feet.

Under act of Congress of August 11, 1888, a preliminary examination of Mystic River was made. In the report on this examination (Annual Report of the Chief of Engineers for 1889, p. 746) a project was submitted for dredging a channel 15 feet deep at mean low water and 100 feet wide, and for reducing five bends in the channel, at an estimated cost of $30,000.

This project was adopted under the river and harbor act of September 19, 1890, appropriating funds for beginning work.

In the conduct of the work of dredging in this river, a rock having over it a least depth of about 9 feet has been uncovered near Morgan Point, and, as it lies within the limits of the proposed channel, it should be removed to a depth of 16 feet, for the safety of navigation. The project for this improvement has therefore been enlarged to provide for the removal of this rock to the depth stated, and the estimated cost of work required to complete the project has been increased $6,600 to permit the removal of this serious obstruction to commerce.

Up to July 1, 1899, 164,722 cubic yards of sand and mud had been dredged. The channel of 15 feet depth and 100 feet width had been extended to the highway bridge at Mystic, the two upper bends had been widened as proposed, and the lower one partly as proposed. No work had been done upon the third or fourth bend. Expenditures to the same date had been $26,705.16. The work done has rendered the navigation of the river somewhat easier. The channel was then completed as designed, from the highway bridge at Mystic down to and including the second bend, 1¼ miles, being 15 feet deep at mean low water and 100 feet wide, with greater widths, up to 300 feet, at the bends. At the fifth or lower bend, which is opposite the shipyard, near the mouth of the river, the 15-foot channel was from 150 to 300 feet wide.

During the fiscal year ending June 30, 1900, the appropriation of March 3, 1899, was applied to the removal of the ledge of rock in the lower bend and to dredging at the entrance and at the fourth and fifth bends, completing the project. All the work was done by contract.

At the close of the fiscal year the maximum draft over the improvement was 15 feet at mean low water. Commerce consists of local supplies, shipbuilding materials, etc.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1891	194	7 to 12	20 to 300	31,998		
1893 *a*						
1894 *a*						
1895	418	5 to 16	100 to 600	23,050		8,948
1896	344	5 to 16	100 to 600	25,880	2,830	
1897	300	5 to 16	100 to 600	21,567		4,313
1898 *a*						
1899	330	5 to 16	100 to 600	32,050	10,483	

a Statistics not received.

The reported value of this commerce for 1899 is $392,350.

No new lines of transportation have been established during the year.

The above statistics do not include the business of the shipyard at Noank, which amounted in 1899 to a total tonnage of 116,328.

July 1, 1899, balance unexpended	$9,894.84
June 30, 1900, amount expended during fiscal year	9,647.99
July 1, 1900, balance unexpended	246.85

(See Appendix E 3.)

4. *Thames River, Connecticut.*—This river is a tidal stream formed by the confluence of two small streams at Norwich, Conn., which is the head of navigation, and extends thence to Long Island Sound, a distance of 15 miles. For 11 miles above its mouth the river has a natural channel of 13 to 80 feet depth, but for the upper 4 miles the available depth was originally but 6 feet at mean low water. The tidal oscillation is 3.1 feet at Norwich and 2.5 feet at the mouth. The lower stretch of the river forms the harbor of New London. A railroad bridge with a draw of 500 feet clear span crosses the river just above New London. This bridge has two clear openings of 205 feet each.

Histories of the improvement of this river near Norwich may be found in the Annual Report of the Chief of Engineers for 1873, page 981, and in that for 1879, page 331, and further information in relation to present project in report for 1895, pages 760–61. Shaws Cove, New London Harbor, is a cove on the west side of Thames River, about 2 miles above its mouth, and constitutes the southern water front of the business portion of the city of New London. It is separated from the river by the embankment and trestle of the New York, New Haven and Hartford Railroad, having a draw of 55 feet width. The natural depth in Shaws Cove was from 2½ to 8 feet at mean low water in a narrow and crooked channel bordered by flats. The latest published maps of the river will be found in the Annual Report of the Chief of Engineers for 1894, page 628, and of Shaws Cove, 1893, page 904. Harbor lines were established in Shaws Cove in 1893.

Under an appropriation made in 1836 a project was adopted for making a channel 14 feet deep at high water (11 feet at low water), by dredging and by building dikes, at an estimated cost of $72,650. Work was stopped in 1839 by exhaustion of appropriations before the project was completed.

Under an appropriation made in 1866 a project was adopted for dredging to make a channel of 11 feet depth at mean low water. This was modified in 1879 to make the depth 14 feet at mean low water, and in 1882 training walls were projected to maintain the channel, the width of which was placed at 200 feet. In compliance with the river and harbor acts of 1888 and 1892, the project was extended to provide for a depth of 16 feet up to Allyn Point, 5 miles below Norwich, and for a channel 100 feet wide, with an anchorage basin adjacent, in Shaws Cove, New London, where the depth was to be 12 feet.

The present project therefore consists in making and maintaining by dredging and a system of training walls a channel 200 feet wide from New London to Norwich to be 16 feet deep at mean low water to Allyn Point, and thence to Norwich to be 14 feet deep, together with dredging in Shaws Cove, New London, to make a channel 100 feet wide and 12 feet deep and an anchorage basin of the same depth and of about 7½ acres area. The estimated cost from the beginning is $457,600. The estimated cost of maintaining the channel is, approximately, $8,000 per year.

Up to June 30, 1899, $388,002.17 had been expended under the present project. Three of the five proposed training walls had been completed, and the fourth nearly so. The proposed river channel was completed to Allyn Point; thence to Norwich it had been made the full depth of 14 feet, with widths from 175 to 100 feet. The 12-foot channel in Shaws Cove had been completed, and the anchorage basin had been half finished.

During the fiscal year ending June 30, 1900, the appropriation of March 3, 1899, was applied to the project and to the completion of the survey provided for in the act. The greater part of the middle ground at Norwich was removed, and nearly all of the projected work in Shaws Cove completed by dredging under contract. The sale of the contractor's plant, and his inability to carry on the work, necessitated the annulment of his contract. The work will be completed by the United States at the earliest practicable date.

Further appropriations will be applied to maintenance and improvement by restoring project dimensions where impaired, and to widening channels which have not yet been opened to full width.

A report upon the survey of New London Harbor, and a project for its improvement, were submitted and printed in House Doc. No. 392, Fifty-sixth Congress, first session; it is also herewith as Appendix E 17.

Commerce at Norwich and Allyn Point consists mainly of coal, lumber and other building materials, iron, and miscellaneous goods. The work done has reduced the cost of transportation by enabling freight to be brought in vessels of 14 feet draft instead of 8 feet. The river commerce of the present day could not have been carried without the increased depth.

Commerce in Shaws Cove consists mainly of lumber and coal. Fishing steamers and pleasure boats use the cove for wintering and for fitting out in the spring. The work done has added materially to the convenience of this navigation, and has increased its amount.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
	No.	Draft.	Tonnage.	Received and shipped.	Compared with preceding report.	
					Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	810	4 to 16	100 to 1,500	467,144		
1891	219	4 to 16	100 to 1,500	609,568	142,424	
1893	1,906	4 to 16	100 to 1,600	546,900		62,668
1894	1,217	4 to 16	100 to 1,600			
1896	1,844	5 to 19	100 to 1,900	424,945		121,955
1897	1,762	5 to 19	100 to 1,900	374,724		50,221
1898	2,431	5 to 19	100 to 1,900	459,588	84,864	
1899 [a]	1,655	5 to 21¼	100 to 2,150	1,209,123		

[a] This report includes all the commerce at and above New London. The previous reports covered only Shaws Cove and Thames River above New London. No comparison between this and the previous reports is possible.

The reported value of this commerce for 1899 was $62,500,679.

Two new lines of transportation were established during the year, one plying between Halifax, New London, and West Indian ports, called the "Colonial Line" of steamers; and the other, a tugboat, chartered by the United States Government, making daily trips from New London to Gull Island and Plum Island, New York.

July 1, 1899, balance unexpended		$20,497.83
June 30, 1900, amount expended during fiscal year		14,503.40
July 1, 1900, balance unexpended		5,994.43
July 1, 1900, outstanding liabilities		1,170.80
July 1, 1900, balance available		4,823.63
Amount (estimated) required for completion of existing project		49,100.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$12,000.00	
For maintenance of improvement	8,000.00	
		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix E 4.)

5. *Connecticut River below Hartford, Conn.*—The Connecticut River below Hartford is a large stream. For the first 21 miles it flows in a winding course, mostly through alluvial meadows, which are overflowed at high water, and which consist of a light, sandy soil, easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent, and generally harder. A gauge has been established at Hartford whose zero is the lowest stage that the water is known to have reached from natural causes. Closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower.

The usual low-water stage of the river in the summer is about 1 foot on this gauge. Spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is 3½ feet; at Hartford it is 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The low-water slope of the river from Hartford to Saybrook averages 0.0458 foot per mile. The bed of the river through the alluvial meadows within 10 miles of Hartford is constantly changing from the undermining of the banks. It is said that in places it has changed its position half a mile. The bars in this part of the river, after being dredged, form again during freshets and ice jams, so that some of them require to be dredged annually, others less frequently. This part of the river was worked upon by corporations and by private parties at various times between 1800 and 1870. Several small stone piers to deepen the channel at shoal places were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

Before the beginning of improvements by the United States the available depth over Saybrook Bar was 7 feet at mean low water; thence to Hartford the available depth over the shoalest of the river bars was about 5 feet at low water, being generally at its minimum after the spring freshets, and increasing as the period of summer low water continued.

By act of July 4, 1836, Congress appropriated $20,000 "for improving the harbor at Saybrook by removing the bar at the mouth of the Connecticut River." A survey was made and a plan submitted for dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of $54,380.50. A channel was dredged 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep in 1840; it almost completely filled up during the storms and freshets of the following winter and spring. No further appropriation was made for this project except to pay a balance due the contractors.

By act of March 2, 1867, Congress ordered a survey of the Connecticut River, which was made that year, and which embraced the principal bars and obstructions between Hartford and Long Island Sound. The report upon this survey, printed in the Annual Report of the Chief of Engineers for 1868, page 754, presented a plan for improving the river below Hartford by dredging to make a channel 8 feet deep at low water and 100 feet wide in the river; 8½ feet deep and 200 feet wide at Saybrook Bar, at the mouth of the river; protecting the shore at Hartford and Wethersfield by piling, and removing Chester Rock, at a total estimated cost of $70,000, with an estimate of $10,000 as the annual cost of maintaining these channels. This project was adopted under authority of the river and harbor act of 1870, which made an appropriation for beginning the work.

In 1873 a project was adopted for improving the channel at Saybrook Bar, at the mouth of the river, by dredging and by building three jetties, at an estimated cost of $336,610. Two of the proposed jetties were completed in 1881, and the third was found to be unnecessary.

In 1880 a plan was adopted for permanent improvements at the worst six bars in the river by riprap wing dams or dikes, mattresses, shore protection, and rectification of the banks, at an estimated cost of $330,487. Dikes at Hartford and Glastonbury bars were built. In 1887, when it had become evident that these constructions would not sufficiently reduce the amount of dredging required each year, the plan was abandoned, and the project of 1870 for annual dredging was reverted to, modified to provide for a depth of 9 feet at extreme low water, together with estimates for completing the Saybrook jetties and dredging between them to 12 feet depth, at an estimated cost of $80,000. This was modified in 1889 to include raising the Hartford Dike to 15 feet above low water, at an estimated cost of $50,000.

The present project is therefore the project of 1870, modified to provide for a channel from Long Island Sound to Hartford, Conn., to be 400 feet wide and 12 feet deep at mean low water across Saybrook Bar, and thence to Hartford to be 100 feet wide (or as nearly that as practicable) and 9 feet deep at extreme low water, or about 10 feet at ordinary summer low tide, the channels to be maintained by annual dredging in the river and by enlarging the Saybrook jetties and the Hartford Dike, at an estimated cost—

For annual dredging	$10,000
For permanent work, which includes the dredging at Saybrook Bar (estimated in 1889)	130,000

The maintenance of navigable channels by annual dredging has been held paramount in the project, and is the only work of improvement done upon this river since 1887, the available funds at no time having been sufficient for enlarging the dike or Saybrook jetties or for additional dredging at Saybrook Bar. The jetties and the channel between them are constantly deteriorating, and are now in a condition demanding attention.

The total amount expended by the United States for this improvement from 1836 to June 30, 1899, was $477,111.25.

On July 1, 1899, annual dredging was in progress to remove the shoals which had formed during the freshets of the preceding spring. Dredging was resumed near the close of the fiscal year to clear the channels after this year's flood, and is in progress at the date of this report. The annual dredging will usually be between May 20 and August 15.

Sketches of the Connecticut River from Hartford to Rocky Hill and of Saybrook Bar were printed in the Annual Report of the Chief of Engineers for 1885, page 636. The river from the Sound to Hartford is shown on Coast Survey charts 253, 254, 255, and 256.

Commerce consists mainly of coal, stone (shipped from Portland and vicinity), building materials, and miscellaneous freight.

The work done and being done has reduced freights on these articles materially, and without the improvements there could be little commerce on the river.

The maximum draft that could be carried June 30, 1900, at extreme low water over the shoalest part of the river under improvement was 9 feet.

Any appropriation in excess of the estimated cost of annual dredging ($10,000) will be applied to repairs of the Saybrook jetties.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890		7 to 12	100 to 600	1,095,000		
1893	1,200	7 to 12	100 to 1,000	650,000		445,000
1894	1,130	7 to 12	100 to 1,000	560,000		90,000
1895	1,300	7 to 12	100 to 1,600	712,000	152,000	
1896	1,300	6 to 12	100 to 1,600	772,000	60,000	
1897	1,350	6 to 12	100 to 1,600	648,000		124,000
1898	1,350	6 to 12	100 to 1,600	665,000	17,000	
1899	1,400	6 to 12	100 to 1,600	700,000	35,000	

The reported value of this commerce for 1899 was $47,000,000.

One new line of transportation was established during the year.

July 1, 1899, balance unexpended		$19,058.75
June 30, 1900, amount expended during fiscal year		9,953.19
July 1, 1900, balance unexpended		9,105.56
July 1, 1900, outstanding liabilities	$1,603.76	
July 1, 1900, amount covered by uncompleted contracts	6,382.24	
		7,986.00
July 1, 1900, balance available		1,119.56
Amount (estimated) required for completion of existing project		110,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$10,000.00	
For maintenance of improvement	10,000.00	
		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix E 5.)

6. *Harbor of refuge at Duck Island Harbor, Connecticut.*—Duck Island Harbor is a bay on the north shore of Long Island Sound. It is about 7 miles west of the mouth of the Connecticut River and midway between the harbors of New Haven and New London. In this distance of 46 miles there is no harbor of sufficient size and depth to shelter any considerable part of the general commerce of the Sound. Duck Island Harbor has a large anchorage area, with depths of 16 feet or more at low tide, and with a good holding bottom. It is sheltered from the north by the mainland, partly sheltered from the east by Menunketesuck Point, and slightly sheltered from the south by Duck Island, an island about 900 feet long (north and south) by 300 feet wide, situated in the mouth of the harbor, rather more than half a mile west-southwest from Menunketesuck Point. The mean tidal oscillation is 3.8 feet.

The project for this improvement, adopted by the river and harbor act of 1890, provides for the construction of three riprap breakwaters of 3,000, 1,750, and 1,130 feet length, respectively, inclosing and sheltering an area of about 115 acres, with two ample entrances. The adopted grade is 6 feet above high water, with crown of 10 feet and slopes of 2 on 3 outside and 1 on 1 inside. The estimated aggregate cost is $463,540. For map see Annual Report of the Chief of Engineers for 1887, page 644.

Work under this project was begun in May, 1891, and up to June 30, 1899, $113,840.20 had been expended, and 2,770 linear feet of the west breakwater had been built, extending westwardly from Duck Island to a low-water depth of 17 feet. A light was maintained at the end of the unfinished structure until August 8, 1899, when it was transferred to the Light-House Establishment.

The west breakwater now affords a limited shelter from south and southeast storms, and is to some extent sought for that purpose. It is within 230 feet of its projected length, and its extremity is in deep water and on soft bottom. The increased unit cost suggests the propriety of considering the west breakwater completed. Future appropriations will be applied to commencing the construction of the breakwater eastward from Duck Island.

The commerce to be benefited by this improvement is the passing commerce of Long Island Sound, which may find it convenient or necessary to seek shelter behind the breakwater during storms. Its value can not be estimated with any accuracy.

A record kept by the light keeper showed that 188 vessels had been anchored behind the breakwater during the year ending July 1, 1897.

No report has been received for this year.

July 1, 1899, balance unexpended	$159.80
June 30, 1900, amount expended during fiscal year	66.20
July 1, 1900, balance unexpended	93.60
Amount (estimated) required for completion of existing project	349,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 6.)

7. *New Haven Harbor, Connecticut.*—New Haven Harbor is a bay in the north shore of Long Island Sound, extending about 4 miles inland and from 1 to 2 miles wide. The Mill and Quinnipiac rivers empty into the head of the harbor from the northeast. They are navigable for about 1 and 3 miles, respectively, above their mouths. The mean range of tides is 6.1 feet.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor in 1867 the available low-water depth from the wharves to Cranes Bar, one-third way down the harbor, was 9 feet; thence to Fort Hale, halfway down, it was 16 feet or over. Just below Fort Hale was a broad shoal of very soft mud extending across the channel, with 13 feet available depth at mean low water. The harbor entrance was partly obstructed by several sunken rocks.

Several plans for removing certain of the rocks at the harbor entrance have been proposed, and work upon two of them was begun. Before they were completed the light-house was removed to Southwest Ledge, and the project for breakwater construction at the harbor entrance was adopted, using these rock shoals as a base and making their removal unnecessary.

Under the appropriation of 1871 the project was extended to include dredging a channel in the harbor. This was at first designed to be 13 feet deep at mean low water and 200 feet wide. When appropriations were made beyond what was required for completion of the project it was from time to time extended, and now consists in making a channel 16 feet deep at mean low water and from 400 to 700 feet wide from Tomlinsons Bridge, at the head of the harbor, to Long Island Sound, by dredging and construction of a dike to contract the channel width over Fort Hale Bar, at an estimated cost from beginning of $348,000. Details concerning the several extensions of the project were printed in the Annual Report of the Chief of Engineers for 1895, page 777.

For maps see Annual Report of the Chief of Engineers for 1889, page 678, page 702 of report for 1896, and House Doc. No. 82, Fifty-fifth Congress, first session.

Harbor lines for New Haven Harbor were established by the Secretary of War November 17, 1894, and were slightly modified and amended by him March 2, 1895, May 20, 1895, and May 5, 1900.

The total amount expended to June 30, 1899, was $325,695.34, at which date a dike had been built from Sandy Point to contract the channel width on Fort Hale Bar, the length of its channel arm, 2,089 feet, being about two-thirds the projected length; the channel up to the wharves had been made 16 feet deep at mean low water and from 400 to 700 feet wide, except across Fort Hale Bar, where the width was 200 feet.

A resurvey of the harbor was made in July and August, 1896, and a revised project presented to Congress and printed in House Doc. No. 82, Fifty-fifth Congress, first session, also in Annual Report of the Chief of Engineers for 1897, page 974. It was adopted in part in the act of March 3, 1899, and a continuing contract authorized, $50,000 being appropriated. The project as adopted by Congress provides for a main channel 20 feet deep at mean low water, 400 feet wide over the outer bar, and 300 feet thence to Tomlinsons Bridge, with three anchorage basins of 20, 16, and 12 feet depth, respectively, at mean low water, to accommodate different classes of shipping.

At the beginning of the past fiscal year a continuing contract was in force for the completion of the project at 6 cents per cubic yard. A large dredge was started on December 8, 1899, which had finished, at the close of the fiscal year, a channel not less than 20 feet deep at mean low water from the Sound to Canal Dock, a distance of about 4 miles, 200 feet in width below Sandy Point dike, and 80 feet in width above that point, 474,304 yards having been removed.

The total yardage is 3,287,000, and at the price bid, with administration costs added, the cost will not exceed $225,000.

On June 30, 1899, the maximum draft that could be carried over the shoalest part of the improvement, which is in the upper part of the harbor, was 14 feet at mean low water. The Fort Hale Channel still retains 16 feet depth, but has narrowed 25 to 50 feet by caving in of the side banks.

The commerce of New Haven consists mainly of coal, iron, lumber, and miscellaneous freights. The increased depth resulting from the improvement has facilitated the transportation of these freights and lessened the delay for tides. A large part of the present commerce could not have been carried on without the improved channel.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
	No.	Draft.	Tonnage.	Received and shipped.	Compared with preceding report. Increase.	Compared with preceding report. Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1880	18,845	6 to 18	100 to 1,000	2,205,813	....	....
1890	18,025	6 to 20	100 to 1,200	2,980,400	774,587	....
1892	29,093	6 to 20	100 to 1,800	3,143,000	162,600	....
1894	29,860	6 to 22	100 to 2,500	3,184,000	41,000	....
1895	31,400	6 to 22	100 to 2,600	3,295,900	111,900	....
1896	28,650	6 to 22	100 to 2,600	3,052,000	....	243,900
1899	28,693	6 to 22	100 to 2,000	3,440,700	388,700	....

The reported value of this commerce for 1899 was $261,586,000.
No new line of transportation was established during the year.

July 1, 1899, balance unexpended		$50,304.66
Amount appropriated by sundry civil act approved June 6, 1900		50,000.00
		100,304.66
June 30, 1900, amount expended during fiscal year		24,338.17
July 1, 1900, balance unexpended		75,966.49
July 1, 1900, outstanding liabilities	$8,688.24	
July 1, 1900, amount covered by uncompleted contracts	168,761.76	
		177,450.00
Amount (estimated) required for completion of existing project		116,915.34
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 7.)

8. *Breakwaters at New Haven, Conn.*—New Haven is the only natural harbor of any considerable area and depth on Long Island Sound between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage grounds exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel in order to reach secure shelter. The mean rise of tide is 6.1 feet.

January 21, 1875, a resolution of the House of Representatives called "for a report from surveys already made in regard to the expediency and estimate of expense of a breakwater between the eastern shore of the entrance to said harbor [New Haven Harbor] and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made January 27, 1875 (printed in the Annual Report of the Chief of Engineers for 1875, Part II, p. 251), with estimates for three different locations for the breakwater.

The river and harbor act of 1879 appropriated $30,000 for the "construction of a breakwater at New Haven, Conn." The several plans were referred to The Board of Engineers, whose report (printed in the Annual Report of the Chief of Engineers for 1880, p. 449) recommended two riprap breakwaters, each to be 12 feet wide on top, the top being 6 feet above mean high water, one to extend from Southwest Ledge to Quixes Ledge, a distance of 3,300 feet, and one 4,200 feet long, extending northwest and southeast and overlying Luddington Rock, the whole estimated to cost $1,311,134. This project was adopted, and under it the east breakwater was built.

The river and harbor act of 1888 authorized the relocation of the western breakwater, and a modification of the project was submitted in the Annual Report of the Chief of Engineers for 1889. The river and harbor act of 1890 appropriated $120,000 for constructing breakwater at New Haven, Conn., "in accordance with plans submitted by the Chief of Engineers in the report for 1889, page 678." The project for this work, thus modified, consists of making a harbor of refuge at the entrance to New Haven Harbor by constructing four breakwaters, one extending from Southwest Ledge to Quixes Ledge; one 5,000 feet long, extending from a point 1,000 feet north 54 degrees east from Luddington Rock southwesterly across the rock; one about 4,200 feet long, extending northwesterly from a point 6,000 feet south 54 degrees west from Luddington Rock, and one about 1,200 feet long, extending southwesterly from Morgan Point on the east side of the harbor entrance. The estimated cost of the whole work from the beginning in 1879 was $2,151,134.

The anchorage outside of the bar which will be sheltered by this breakwater exceeds 2,000 acres, and has depths of 9 to 26 feet at mean low water.

A sketch of New Haven Harbor, showing the location of the breakwaters as contemplated under the existing project, was printed in the Annual Report of the Chief of Engineers for 1889, page 678, and the last printed sketch may be found in annual report for 1896, page 702

Up to July 1, 1899, the breakwater from Southwest Ledge to Quixes Ledge had been completed, and the Luddington Rock breakwater had been made 4,500 feet long, and 1,490 feet of the west breakwater had been built. The total expenditures to this date had been $833,254.09. The balance available, with future appropriations, will be applied to extension of the west breakwater at its western extremity, and in repair of any settlement which may have occurred in the part last built.

Four lights were maintained on the breakwaters until June 28, 1899, when three of them were transferred to the Light-House Establishment.

The commerce benefited by this work is the passing commerce of Long Island Sound. During 1895, 151,356 vessels were observed passing the breakwaters, and 3,925 vessels were observed at anchor in the mouth of the harbor, where they were partly under their shelter.

No estimate of the value of this commerce can be made.

July 1, 1899, balance unexpended	$1,745.91
June 30, 1900, amount expended during fiscal year	245.05
July 1, 1900, balance unexpended	1,500.86
Amount (estimated) required for completion of existing project	1,316,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	44,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 8.)

9. *Housatonic River, Connecticut.*—The Housatonic is a long, shallow river running southward through Massachusetts and Connecticut, emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth, it receives the discharge of the Naugatuck, a small, rapid river. This point, which has been regarded as the head of navigation, is nearly at the head of tide water. About a mile above there is a dam across the Housatonic River furnishing large water power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (six in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth. The mean rise of tide at Derby is 4.2 feet; at the mouth of the river it is about 6.2 feet.

By act of Congress of July 11, 1870, a survey of the Housatonic River was ordered. The report on the survey, printed in the Annual Report of the Chief of Engineers for 1871, page 781, presented estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river and 150 feet wide in the river, by dredging, removing Drews Rock, and building a jetty at Sow and Pigs Reef, the channel at the mouth to be protected on the east side by a breakwater. The estimated cost was $404,961, of which $368,475 was the estimated cost of the breakwater.

This project was adopted under the river and harbor act of 1871, which made an appropriation for beginning the work. Dredging was done on the several bars in the river, the jetty at Sow and Pigs Reef was built, and under a modification of the project a jetty was built at Drews Rock. The latter, however, caused a shoal to form below the rock, and in 1888 the rock was removed, as originally proposed. Up to 1888 no work had been done upon the bar at the river's mouth. This was considered the most important work in the river, but the channel could not be permanently deepened until the breakwater was constructed, and funds sufficient for that work had not been appropriated. In 1885 and 1886 certain oyster growers who wished to use dredged material for oyster beds offered to dredge across the outer bar without expense to the United States; they removed 52,888 cubic yards of sand and shells, making a channel 70 feet wide and 9 feet deep. The first severe storm following completely filled the outer part of the channel.

In 1887 the estimates of cost were revised and the project modified, reducing the width of channel in the river to 100 feet and proposing a riprap breakwater to be built to half tide for the first 3,250 feet from shore, and thence for about 2,500 feet farther to be built to 6 feet above high water, at an estimated cost of $202,000. The reasons for this were presented in Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and in the Annual Report of the Chief of Engineers for 1888, page 554. This modification of the project was adopted under the river and harbor act of 1888. In 1893 the project was further modified to provide for building a small dike below Stratford to reduce the amount of dredging required.

The present project for improvement is, therefore, the project of 1871, subsequently modified, and consists in making and maintaining a channel 7 feet deep at mean low water from Long Island Sound to the head of navigation, about 13 miles, to be 100 feet wide in the river and 200 feet wide over the bar at the mouth, by dredging, removing Drews Rock, building a jetty at Sow and Pigs Reef and a small dike at the bend below Stratford, and protecting the channel at the mouth of the river by a breakwater about 5,750 feet long. The estimated cost, from the beginning in 1871, is $275,500.

A survey called for in the river and harbor act of June 3, 1896, was made, and a report and revised project submitted March 16, 1897. The report is published in House Doc. No. 16, Fifty-fifth Congress, first session, and in the Annual Report of the Chief of Engineers for 1897, page 979.

For maps of the whole navigable part of the river see Annual Report of the Chief of Engineers for 1882, page 616, and House Doc. No. 16, Fifty-fifth Congress, first session; and of the mouth, Annual Report of the Chief of Engineers for 1886, page 642, and 1887, page 608.

July 1, 1899, Drews Rock had been removed, the jetty at Sow and Pigs Reef had been built, the dike below Stratford had been made 555 feet long, and the breakwater at the river's mouth had been made 5,821 feet long, the 3,250 feet nearest shore being built to about half-tide level, and the outer part being built 4 to 6 feet above high water.

Dredging had been done on the several bars in the river and at the mouth, all at a total cost of $212,173.87. The last dredging on the bars above the mouth of the river was completed October 23, 1897, at which time channels over the bars were left clean at project dimensions. On June 30, 1899, 8 feet at low water could be carried across the bar at the mouth of the river and from 5 to 7 feet over the bars above the mouth.

During the past fiscal year a contract was made for the application of a part of the appropriation of March 3, 1899, to the approved project by dredging across the bars to restore the project dimensions. At the close of the fiscal year work under this contract had not been begun.

Additional appropriations will be applied to the construction of the dike near Stratford and in dredging the bars between the breakwaters to restore project dimensions.

The commerce consists mainly of coal, iron, building materials, oysters, raw materials for manufacturers, and miscellaneous freight.

The work done and being done has enabled vessels to enter the lower river in safety, instead of waiting for high tide in an exposed situation outside the mouth of the river; and a large part of the commerce could not have been carried on without the improved channel.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890 *a*	15,124	1 to 8	1 to 300	138,800		
1892 *a*	12,215	1 to 8	1 to 400	202,325	63,525	
1893 *a*	12,381	1 to 8	1 to 450	159,830		42,495
1896 *b*	1,260	2 to 8	3 to 450	79,647		80,183
1897	1,383	2 to 8	3 to 450	83,200	3,558	
1898 *c*	650	2 to 8	3 to 450	77,000		6,200
1899		2 to 8	3 to 450	64,712		12,288

a Includes the small vessels used in the oyster industry at mouth of river.
b No report received between 1893 and 1896.
c Does not include freight tonnage of oyster industry at mouth of river.

The reported value of this commerce for 1899 was $401,150.

No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended	$16,326.13
June 30, 1900, amount expended during fiscal year	414.80
July 1, 1900, balance unexpended	15,911.33
July 1, 1900, amount covered by uncompleted contracts	4,900.00
July 1, 1900, balance available	11,011.33

Amount (estimated) required for completion of existing project		47,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$20,000.00	
For maintenance of improvement	4,000.00	
		24,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix E 9.)

10. *Bridgeport Harbor, Connecticut.*—This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about a mile at the mouth decreasing to 200 feet between the opposite wharves at its upper end. The channel in every part of the harbor is comparatively narrow, and is crossed by four drawbridges. Before the first work was done by the United States the depth over the bars near the harbor's mouth was 5 feet at low water, and above the bridges from 2 to 5 feet. The mean rise of tide is 6½ feet.

In 1836 Congress appropriated $10,000 for improving this harbor, and again a like amount in 1852. These sums were expended in dredging near the mouth of the harbor, making channels 60 to 100 feet wide and 8 feet deep or more at low tide. The depths made did not prove permanent.. Under acts of Congress of June 23, 1866, and July 11, 1870, surveys or examinations of the harbor were made, and the report upon the latter examination proposed a plan for improvement by dredging a channel 100 feet wide and 12 feet deep at extreme low water, and protecting the outer channels by a breakwater extending about 3,000 feet from Long Beach, on the east side of the harbor entrance, all at an estimated cost of $124,000. This project was adopted in 1871, when an appropriation was made for beginning work upon it.

In 1875 the dimensions of the proposed channel were modified to make it 12 feet deep at mean low water and from 200 to 300 feet wide up to the lower or Stratford Avenue Bridge. This was accomplished in 1882, and then the project was again modified to include widening the channel between the inner beacon and the Naugatuck Dock, a distance of 3,800 feet, to prevent overcrowding the main channel by vessels entering for shelter, at an estimated cost of $60,000. This work has been nearly completed.

In compliance with the terms of the river and harbor acts of 1878 and 1888, the project was extended to include a channel 100 feet wide and 9 feet deep to the head of navigation at Berkshire Mills, and again, under the terms of the river and harbor act of 1890, to include a breakwater from The Tongue to the inner beacon. The river and harbor act of 1894 also authorized the expenditure of the appropriation made for deepening the channel at the outer bar, and the project was extended to provide for 15 feet depth at that point.

Under the authority of the river and harbor act of 1894 a survey of the harbor was made, and the report printed in the Annual Report of the Chief of Engineers for 1896, pages 803–805, and also in House Doc. No. 61, Fifty-fourth Congress, first session, submitted estimates for extending the 15-foot channel to the lower bridge, making it 300 feet wide up to the inner beacon and 200 feet wide above that beacon, which, with the unfinished work of the then existing project, was estimated to cost $90,000.

The river and harbor act of June 3, 1896, appropriated $28,000 for continuing the improvement in accordance with the modified project, $10,000 of which "shall be expended upon Yellow Mill Pond for constructing a channel 12 feet deep and 200 feet wide from the main channel to the causeway, conditioned upon the construction by the city of Bridgeport of a drawbridge at the causeway upon plans approved by the Secretary of War."

In the act of March 3, 1899, Congress adopted a new project for Bridgeport Harbor, embracing the channels previously known as

Bridgeport Harbor, Johnsons Creek, and Black Rock Harbor, all of which are avenues of Bridgeport commerce.

The project provides for—

First. The main channel 18 feet deep at mean low water, 300 feet wide from the outer bar to the inner beacon; thence 200 feet wide to the lower or Stratford Avenue Bridge.

Second. Anchorage: For deep draft, 18 feet at mean low water, 500 feet wide, and 2,000 feet long, adjacent to the main channel on the west and immediately above the inner beacon; for light draft, 12 feet deep at mean low water, 500 feet wide, and 1,500 feet long, adjacent to the main channel on the west between the 18-foot anchorage and Naugatuck Wharf, and of the same depth at mean low water adjacent to the main channel on the east between the steel works point and the lower bridge extending to the harbor line.

Third. Pequonnock River Channel from the lower bridge to the head of navigation, about 1 mile, 12 feet deep at mean low water and 100 feet wide.

Fourth. Yellow Mill Channel from the main channel to the head of Yellow Mill Cove, about 1 mile, 12 feet deep at mean low water and 100 feet wide.

Fifth. Johnsons River Channel from the main channel to the head of navigation, about three-fourths of a mile, 9 feet deep at mean low water and 100 feet wide.

Sixth. Black Rock Channel from the head of Black Rock Harbor to the junction of Cedar and Burr creeks, thence up each of these creeks to the head of navigation, with lengths, respectively, of 1½ miles and one-half mile, 9 feet deep at mean low water and 100 feet wide.

Seventh. The repair and maintenance of the outer and inner breakwaters of the main channel and the one connecting Fayerweather Island with the mainland as now built, and the construction and maintenance of shore protection on Fayerweather Island to check the shifting of the beach.

An appropriation of $50,000 was made in the act cited and a continuing contract authorized.

Harbor lines for this harbor were established by the Secretary of War July 1, 1893, and modified September 19, 1898.

The last sketch of Bridgeport Harbor in the Annual Report of the Chief of Engineers was printed in the report for 1893, page 940, and a complete map was published in House Doc. No. 61, Fifty-fourth Congress, first session.

The amount expended to June 30, 1899, was $297,482.83, and at that date the channel, 12 feet deep at mean low water at the entrance, was 200 feet wide for a length of about 1,300 feet; thence to the inner beacon, 3,100 feet, the 12-foot channel was about 300 feet wide, and thence to Naugatuck Dock, 3,800 feet, it was 770 feet wide. From that dock to the lower or Stratford Avenue Bridge, 2,000 feet, it had shoaled so that the depth was from 10 to 11 feet. Within the limits of the 12-foot channel a part of the 15-foot channel had been dredged, which extends from the entrance to the inner beacon, a distance of 1 mile, and is 220 feet in width. Above the lower bridge the channel, dredged 9 feet deep and 60 to 100 feet wide, was still nearly of that depth and width.

A channel 12 feet deep at mean low water and 100 feet wide had been dredged from the main channel to Yellow Mill Bridge.

The breakwater at Long Beach, built in 1871–1873, had settled somewhat, and, while still adequate for the protection of the channels contemplated by the earlier projects, required some repairs and extension to secure the desired protection for the broader and deeper channels of the present project.

The breakwater from The Tongue to the inner beacon had been built to its full projected length with reduced cross section. It required some enlargement to make it permanent.

At the beginning of the fiscal year a contract was in force for completing the project at 5 cents per cubic yard for dredging and $2 per ton for riprap, provided the work was executed in accordance with certain limitations as to rate of progress. At the close of the fiscal year work under this contract had not been begun.

The maximum draft of water that can be carried through the improved channels is 10 to 15 feet to the lower bridge and 8 to 9 feet thence to the upper end.

The commerce of this harbor consists of coal, iron, building materials, and general merchandise. The improvement already made has made it possible to use larger vessels, without which the present commerce of the harbor could not be carried on.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	24,273	6 to 18	100 to 1,000	1,314,157	a 297,000	....
1892	24,223	6 to 18	100 to 1,000	1,324,190	10,033	....
1894	18,572	6 to 18	50 to 1,250	968,659	....	355,531
1895	19,223	6 to 18	50 to 1,250	1,045,769	77,110	....
1896	18,723	6 to 18	50 to 1,250	1,030,451	....	15,318
1897	18,564	12 to 18	100 to 1,250	1,081,973	51,522	....
1898	18,770	12 to 18	100 to 1,250	1,196,563	114,590	....
1899	15,991	12 to 18	100 to 1,250	1,014,564	....	181,999

a Over 1889.

The reported value of this commerce for 1899 is $15,217,460.

No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended		$50,517.17
Amount appropriated by sundry civil act approved June 6, 1900		50,000.00
		100,517.17
June 30, 1900, amount expended during fiscal year		365.67
July 1, 1900, balance unexpended		100,151.50
July 1, 1900, outstanding liabilities	$5.00	
July 1, 1900, amount covered by uncompleted contracts	151,325.00	
		151,330.00

Amount (estimated) required for completion of existing project	63,178.50
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	63,178.50
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 10.)

11. Saugatuck River and Westport Harbor, Connecticut.—Saugatuck River is a tidal stream, the navigable part of it extending inland about

4½ miles by course of channel from Long Island Sound to Westport, Conn. It has a natural depth of 5 feet at mean low water, in a rather narrow, crooked channel, up to the railroad bridge at Saugatuck, about 3 miles from the sound; thence the depth, before improvement, decreased gradually until at Westport it was less than 1 foot. The channel was somewhat obstructed by rocks in its upper part.

For nearly 2 miles below Westport the stream is from 200 to 1,200 feet wide; below this it expands into a rather broad inner bay, with a narrow channel following the west, south, and east shores and then turning abruptly to the southeast and passing to the sound between Cedar Point on the north and Cockenoes Island on the south. On the south side of the inner bay lies Great Marsh, which is connected with Cockenoes Island by a broad sand flat, nearly bare at low tide; and east of the island a reef of bowlders extends eastward 1½ miles, so that the only entrance to the harbor at low tide is to the eastward of this reef.

The navigable part of the river is crossed by three bridges, all having draws of sufficient size for the commerce of the stream. The uppermost is a wagon bridge, at Westport; 1¼ miles below is a wagon bridge, near Saugatuck, and a quarter of a mile farther down is the bridge of the New York, New Haven and Hartford Railroad.

The mean rise of tide is about 7 feet.

Improvements of this locality have been made by the United States under the several titles of Saugatuck Harbor, Cedar Point, Westport Harbor, and Saugatuck River.

In 1826 Congress appropriated $400 for a survey of the river and harbor of Saugatuck. In the report of the survey a project was submitted for deepening the channel near Westport, removing two rocks in the river, building a breakwater on Cedar Point, and cutting a canal through Great Marsh, at a total estimated cost of $6,128.65. The project was completed nearly as designed in 1840. The breakwater at Cedar Point was made about 390 feet long, the top being 4 feet above high water and 10 feet wide, and the canal was excavated 1,350 feet long, 44 feet wide at the bottom, and 4 feet deep, and part of the east side was protected by a dry wall. The amount appropriated for and expended upon this project was $14,044.

Appropriations made in 1867 and 1870, $2,500 each, were applied to surveys and to repairing and extending the breakwater at Cedar Point.

Under the river and harbor act of 1882 a survey of the river was made, but no project for improvement was adopted.

A preliminary examination of Saugatuck River was ordered by the river and harbor act of 1890. A project was adopted under the appropriation made in 1892 for beginning work, and it consisted in making a channel 4 feet deep at mean low water and 60 feet wide up to the village of Westport, at an estimated cost of $10,000. This work was completed in 1896.

The river and harbor act of 1894 ordered a survey of Westport Harbor, which was made. The report of this survey is printed in the Annual Report of the Chief of Engineers for 1896, page 806. It is also printed with map in House Doc. No. 67, Fifty-fourth Congress, first session. It proposed a further improvement to provide for repairing the Cedar Point breakwater, removing a ledge opposite Stony Point, or dredging around it, and removing bowlders from the channel, at a total estimated cost of $8,000. Under the terms of the river and harbor act of 1896, appropriating $3,000 for improving Westport Harbor, Connecticut, the project of 1892 was extended to include this work, and the estimated cost was in consequence increased to $18,000.

A sketch of this river and harbor was printed in the Annual Report of the Chief of Engineers for 1894, page 670.

The total amount expended on this improvement up to the close of the fiscal year ending June 30, 1899, was $31,894.90, at which date the 4-foot channel had been completed to Westport, the head of navigation, with width generally of 60 feet.

The Cedar Point breakwater, repaired and extended in 1897, was in good condition. No work was done during the fiscal year, from lack of sufficient funds.

Additional appropriations will be applied to further removal of bowlders from the channel and restoration of channel dimensions where necessary.

The commerce consists of coal, manufactured goods, farm produce, and miscellaneous articles. The improvements made have rendered navigation of the river practicable at less than full high water.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1893	322	6 to 11	100 to 300	44,400	....	....
1894	320	6 to 8	100 to 250	59,700	15,300	....
1895	....	6 to 10½	100 to 300	28,940	....	30,760
1896	345	4 to 10½	50 to 300	33,507	4,567	....
1897 *a*	....	....	....	....	....	....
1898	106	4 to 10½	50 to 300	22,550	....	10,957
1899	109	4 to 10½	50 to 300	20,500	....	2,050

a Statistics not received.

The reported value of this commerce for 1899 was $72,680.

No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended	$549.10
June 30, 1900, amount expended during fiscal year	11.20
July 1, 1900, balance unexpended	537.90
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 11.)

12. *Norwalk Harbor, Connecticut.*—Norwalk Harbor or River is a tidal estuary, with a narrow channel extending about 3 miles north from Long Island Sound to the town of Norwalk. Above Norwalk the river is a small fresh-water stream. South Norwalk is on the west bank of the river, 1½ miles below Norwalk. At this point the river is crossed by two drawbridges, the lower one a highway bridge and the other (450 feet above) the bridge of the New York, New Haven and Hartford Railroad. The mean tidal range is 7.12 feet.

In 1867 a company was incorporated under the laws of the State of Connecticut for the improvement of the river. Little work was done, and when the improvement was begun by the United States the low-water depth to South Norwalk was 5 feet and to Norwalk but 1 foot.

By act of March 2, 1829, Congress appropriated $80 for making a survey of the harbor of Norwalk, Conn., with a view to its improvement. The survey was made, and estimates were submitted for making a channel either 10 or 12 feet deep at ordinary high tide, but no money was appropriated for the improvement.

The river and harbor act of 1871 ordered another survey, which was made in that year. The report, printed in Senate Ex. Doc. No. 23, Forty-second Congress, second session, and also in the Annual Report of the Chief of Engineers for 1872, page 900, proposed dredging a channel 6 feet deep and 100 feet wide from Long Island Sound to Norwalk, at an estimated cost of $34,000. This project was adopted under the river and harbor act of 1872. In 1880 the project was modified so as to increase the depth below South Norwalk to 8 feet at mean low water, and the estimate of cost was increased to $84,000, to include this modification and the dredging which had already been done for maintenance of channels. This project was considered completed in 1892.

Under the terms of the river and harbor act of 1894, appropriating $15,000 for continuing this improvement, a project was adopted for dredging and removing the shoal called Ferrys Point, on the west side of the channel, between the railroad docks and Jenning's wharf, making 6 feet depth at mean low water, and, if funds should permit, for widening the bend at Keysers Island, near the harbor entrance, making a depth of 9 feet at mean low water, at a total estimated cost of $15,000.

A survey of Norwalk Harbor, ordered by the river and harbor act of 1894, was made, and the report, printed in House Doc. No. 50, Fifty-fourth Congress, first session, also in the Annual Report of the Chief of Engineers for 1896, page 813, contained estimates for an extension of the improvement to provide for a channel 10 feet deep and 150 feet wide to South Norwalk, and for widening two bends at the harbor entrance, at a cost of $62,000. This project was adopted by the river and harbor act of 1896, which appropriated money for beginning work under it, and the project of 1894, thus modified, consists in removing the shoal at Ferrys Point to a depth of 6 feet at mean low water, in making a channel to South Norwalk 150 feet wide and 10 feet deep at mean low water, and in widening the two bends at the harbor entrance, at an estimated cost from the beginning, in 1894, of $77,000.

The maintenance of this channel and of the existing channel above South Norwalk is estimated to cost about $2,000 per year.

A sketch of Norwalk Harbor, Connecticut, was printed in the Annual Report of the Chief of Engineers for 1885, page 656, and a complete map of the harbor was published in House Doc. No. 50, Fifty-fourth Congress, first session.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1899, was $107,583.01, and on that date a practicable channel 8 feet deep at mean low water extended from Long Island Sound to the railroad bridge at South Norwalk, and a channel 6 feet deep at mean low water from the railroad bridge to the docks at Norwalk. The present project depth of 10 feet at mean low water is not available, because work under this project has covered a part of the channel only.

During the fiscal year the appropriation of March 3, 1899, was applied to the approved project by dredging to restore channel dimensions where found impaired. The work was done under a contract in force at the beginning of the year.

No examination has been made since the close of work in May, 1897, and, no reports to the contrary having been received, it is believed that the depths of 8 feet below, and 6 feet above, the railroad bridge at South Norwalk are still unimpaired.

Future appropriations will be expended in developing the channel of South Norwalk Harbor.

The commerce of this harbor consists mainly of coal, lumber, oysters, and miscellaneous freights. The increased depth resulting from the improvements has been of benefit to all classes of vessels, and to much of the present commerce is absolutely indispensable.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1886	2,370	9 to 10	....	438,600	....	....
1890	1,520	7 to 12	100 to 500	312,500	....	126,100
1891	2,126	7 to 12	100 to 500	368,500	56,000	....
1894	....	....	....	136,800	....	231,700
1895	861	4 to 18	50 to 600	201,095	64,295	....
1896 *a*	998	4 to 14	50 to 600	146,045	....	55,050
1899	1,019	4 to 14	50 to 600	164,755	18,710	....

a Does not include trips made by 43 oyster steamers, with total tonnage of 2,505 gross tons.

The reported value of this commerce for 1899 was $6,386,110.

No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended		$2,416.99
June 30, 1900, amount expended during fiscal year		2,247.24
July 1, 1900, balance unexpended		169.75
Amount (estimated) required for completion of existing project		50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$13,000.00	
For maintenance of improvement	2,000.00	
		15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix E 12.)

13. Five-mile River Harbor, Connecticut.—This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about 1 mile long and from 300 to 800 feet wide. About three-fourths of a mile above its mouth it runs bare at low tide. At the mouth the natural low-water depth was 3 feet, increasing to 9 feet at a point 750 feet out into the Sound. The mean rise of the tide is about 7 feet.

Since 1848 Five-mile River has been largely engaged in oyster growing, and in this business now employs about 140 vessels, which, without the improvement, could only enter or leave the harbor at high tide. Consequently during their busy season they would be obliged to lie up for the night at other and less convenient harbors.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was reported on under date of December 7, 1886 (printed in the Annual Report of the Chief of Engineers for 1887, p. 639).

In this report a project for improvement was proposed which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor and to be about 6,000 feet long. The project was adopted in 1888, when work under it was ordered by appropriation of $5,000, made by act of Congress of August 11, 1888.

Harbor lines were established for this harbor by the Secretary of War January 26, 1892.

A sketch of Five-mile River Harbor was printed in the Annual Report of the Chief of Engineers for 1894, page 676.

Up to July 1, 1899, 132,908 cubic yards had been dredged under this project, making the channel about 4,540 feet long, the lower 1,900 feet being 100 feet wide and the remainder 60 feet wide, all to a depth of 8 feet at mean low water. Further dredging is necessary to complete the projected work.

The total amount expended on this improvement to June 30, 1899, was $19,976.59.

The commerce of this harbor consists mainly of coal and shellfish.

The increased depth has rendered possible the general use of the harbor by boats engaged in this business.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1889		2 to 7½	5 to 150			
1891		1½ to 8	2 to 175	10,000		
1892		1½ to 8	2 to 100			
1894	739			11,298	1,298	
1895	739			11,298		
1897 *a*	8,506	3 to 8	40 to 104	17,160	5,862	

a Includes trips made by 40 small oyster boats.

The reported value of this commerce for 1897 was $152,247.

No statistics for 1898 or 1899 have been received.

No new lines of transportation have been established during the year.

The business of this harbor depends upon amount and value of oysters raised rather than upon tonnage of freights.

July 1, 1899, balance unexpended	$2,523.41
June 30, 1900, amount expended during fiscal year	2,465.00
July 1, 1900, balance unexpended	58.41
Amount (estimated) required for completion of existing project	22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 13.)

14. *Stamford Harbor, Connecticut.*—This harbor is on the north shore of Long Island Sound, about 6 miles east of the New York State line. It consists of a bay about a mile long and a mile broad, at the head of which two channels extend up nearly a mile toward the middle of the city. The West Branch, known as Mill River, is a small stream dammed at Oliver Street Bridge, the head of the harbor. The original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 7-foot curve in the bay was about 7,500 feet below the bridge. All the wharves are in the upper half of this distance. The East Branch was originally a crooked stream running through salt marshes; it was straightened and deepened by private enterprise and was known as the "Canal." Though nominally under control of the corporation which deepened it, the East Branch has been for a long time practically, and recently has been formally, opened to public use. In 1892 it had an available depth of 6½ feet at mean low water, with width of about 60 feet nearly to its head, which is about 1½ miles above its junction with the West Branch.

The mean rise of tide is 7.4 feet.

A survey of Stamford Harbor, ordered by act of Congress of March 2, 1829, was made, and with the report estimates were submitted for dredging channels either 10 or 12 feet deep at mean high water. No work was done under this plan.

The river and harbor act of 1882 authorized a survey of the harbor, which was made the following year. The report proposed improvement by dredging a channel through the West Branch 80 feet wide and 5 feet deep at mean low water, at an estimated cost of $20,000. The project was adopted under the river and harbor act of 1886, which made appropriation for beginning the work, and in December, 1891, after $20,000 had been appropriated and expended, the project was reported completed. The channel of the West Branch had been made 5 feet deep to the head of the harbor, with 80 feet width, except in the upper 1,000 feet, where the width was from 50 to 70 feet.

The river and harbor act of 1890 ordered a survey of Stamford Harbor. The report upon the survey presented a plan for further improving the West Branch at an estimated cost of $95,000. Under the terms of the river and harbor act of 1892 this project was modified to include an improvement of the East Branch and was adopted as modified. The present approved project therefore consists in dredging in the West Branch to make a channel 150 feet wide and 7 feet deep at mean low water, with a basin between the harbor lines at the head of the harbor, and in the East Branch to make a channel 9 feet deep at mean low water, to be 100 feet wide for 8,535 feet, and thence to the head of the harbor, about 1,200 feet, to be 50 feet wide. The estimated cost from the beginning in 1892 is $123,500.

Harbor lines were established in the West Branch by the Secretary of War February 28, 1890.

A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for 1893, page 956.

The amount expended to the end of the fiscal year ending June 30, 1899, was $54,437.32, at which date the West Branch channel was completed to the turning basin at the head. The East Branch had a channel 9 feet deep at mean low water, from 60 to 80 feet wide up to the steamboat dock, about 8,000 feet, and thence for 1,200 feet from 40 to 60 feet wide.

Work under the appropriation of March 3, 1899, consisted in the removal of 7,524 yards from the West Branch, thereby extending the channel 7 feet deep and 60 or more feet wide to the harbor line at the north end; and in the removal of 21,714 yards from the East Branch, thereby continuing the channel 9 feet deep and 40 to 60 feet wide above the steamboat dock and forming a turning basin at the upper end. The project contemplates widening the channel in the East Branch and making a turning basin in the West Branch.

The commerce of this harbor consists mainly of coal, building materials, and unclassified freights. The improvements made have rendered access to the wharves much easier for the class of vessels used in this traffic.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	700	5 to 12	10 to 375	50,000	*a* 3,890	....
1892	2,188	5 to 12½	....	154,607	104,607	....
1893	2,364	5 to 13	40 to 613	233,339	78,732	....
1894	2,075	5 to 15	40 to 542	199,964	....	33,375
1895	2,019	5 to 15	40 to 550	220,506	20,542	....
1896	2,210	5 to 15	20 to 550	373,758	153,252	....
1898	2,017	5 to 15	20 to 550	252,183	....	121,571
1899	2,034	5 to 15	20 to 550	257,687	5,504	....

a Over 1889.

The reported value of this commerce for 1899 was $5,826,225.

July 1, 1899, balance unexpended	$6,562.68
June 30, 1900, amount expended during fiscal year	5,314.16
July 1, 1900, balance unexpended	1,248.52
July 1, 1900, outstanding liabilities	3.50
July 1, 1900, balance available	1,245.02
Amount (estimated) required for completion of existing project	82,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 14.)

15. *Harbor at Coscob and Mianus River, Connecticut.*—This harbor is a tidal inlet extending about 2 miles northwardly from Long Island Sound to the village of Mianus, at a point 4 miles east of the New York State line. It has a high-water width of from 800 to 2,000 feet, but the low-water channel is narrow and bounded by mud flats. At low tide there was in 1892, before the improvement of the harbor was begun, a natural depth of 7 feet or more, with width of about 200 feet for the first half mile, the depth above gradually decreasing to almost zero at the head of the harbor. About three-quarters of a mile below Mianus the stream is crossed by a drawbridge of the New York, New Haven and Hartford Railroad. The commerce of the harbor is

practically confined to the supplies of the communities along its shores. At Coscob, above the railroad bridge, is a shipyard, where a considerable number of small boats are repaired and some built. At Riverside, below the bridge, are the houses and docks of the Riverside Yacht Club.

The mean rise of tide is about 7½ feet.

Under authority of the river and harbor act of 1890 a survey of the harbor was made. The report on the survey, printed in the Annual Report of the Chief of Engineers for 1891, page 855, contains a plan and estimate for improvement by dredging to make a channel 6 feet deep at mean low water, with 150 feet width below the railroad bridge and 100 feet width above the bridge to Mianus, at an estimated cost of $36,000. This project was adopted under the river and harbor act of 1892, which made an appropriation for beginning work.

By act of August 18, 1894, Congress made appropriation for continuing the improvement, "including a survey of the lower part of the harbor with a view of making a turning basin therein." The report upon this survey, printed in the Annual Report of the Chief of Engineers for 1895, page 881, presented plans for a turning basin just inside the harbor entrance, to be 7 feet deep at mean low water and 300 feet wide, to be made by widening the channel on the west side for a length of 2,000 feet, measured along the channel, and 1,500 feet at the west side of the basin. The estimated cost was $18,000.

This modification of the project was adopted under the terms of the river and harbor act of 1896, and the present project for this improvement consists in dredging to make a channel 6 feet deep at mean low water, to be 150 feet wide up to the railroad bridge, and thence to Mianus to be 100 feet wide, with a turning basin on the west side of the channel near the harbor entrance 7 feet deep at mean low water, 300 feet wide, and extending 2,000 feet along the channel, at a total estimated cost of $54,000.

A sketch of Coscob Harbor and Mianus River was printed in the Annual Report of the Chief of Engineers for 1893, page 958, and one of the lower part of this harbor in the report for 1895, page 882.

The amount expended on this improvement to June 30, 1899, is $17,454,81; and to the same date the channel had been dredged 150 feet wide and 6 feet deep up to the railroad bridge, and of the same depth 100 feet wide for 1,300 feet above the bridge. One-half of the turning basin, 7 feet deep at mean low water, was also dredged.

The contract, which was begun near the close of the last fiscal year, covered the dredging of about 6,500 yards and was completed July 7, thereby extending the 100-foot channel at 7 feet depth to a point 1,600 feet above the railroad bridge, and beyond this to the stone dock about 50 feet wide and 5 feet deep.

At the close of the last dredging the depth in turning basin was 7 feet and in channel 6 feet, and no impairment of same has been reported since that time.

The estimate submitted for fiscal year 1902 is to provide for extension of the 100-foot channel from its present upper terminus, a little below Lockwood's dock.

The commerce of this harbor is mainly coal, lumber, and miscellaneous products. The benefit to commerce consists only in a broader and deeper channel in the lower part of the harbor, the increased depth being not yet extended to the upper landings.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	3,732	2 to 9	3 to 80	46,900		
1894 *a*	342	4 to 8	25 to 100	51,600	4,700	
1897 *a*	424	4 to 8	25 to 100	61,500	9,900	
1898 *b*	36	4 to 8	25 to 100	25,000		36,500
1899	92	4 to 8	25 to 100	9,360		15,640

a The trips of 83 yachts which belong to the Riverside Yacht Club and anchor in this harbor are not included in the number of vessels given.
b Barges only; daily steam packet withdrawn.

The reported value of this commerce for 1899 was $148,800.

No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended	$1,545.19
June 30, 1900, amount expended during fiscal year	1,374.88
July 1, 1900, balance unexpended	170.31
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 15.)

16. *Greenwich Harbor, Connecticut.*—Greenwich Harbor is a shallow bay about 2 miles east from the New York State line and extending nearly a mile northward from Long Island Sound. Before improvement the upper part of the harbor ran bare at ordinary low water, and vessels landing at any of the docks, except those in the outer harbor, could enter only at full tide and with draft of not over 6 feet.

The mean rise of tide is about 7½ feet.

The preliminary examination of this harbor was made in compliance with the river and harbor act of 1894, and the report submitted in House Ex. Doc. No. 25, Fifty-third Congress, third session. It is also printed in the Annual Report of Chief of Engineers for 1895, page 860. The improvement recommended was adopted under the river and harbor act of 1896, which appropriated money to begin the work.

A channel 90 feet wide is to be made from the mouth of the harbor to a causeway at its head, a distance of about a mile, to be 9 feet deep at mean low water to the lower docks and 6 feet deep above. The upper end is slightly enlarged to form a turning basin. The estimated cost was $20,000. Harbor lines were established in 1895.

Up to June 30, 1899, a channel 6 feet deep at mean low water and 45 feet wide was dredged from the 6-foot curve opposite the lower dock to the upper dock, near the upper end of the proposed channel, a distance of half a mile. The expenditures had been $5,121.85.

At the close of work on January 15, 1898, the low-water depth over the improvement was 6 feet, and it is believed that that depth still exists. Owing to lack of funds no work was done during the past fiscal year.

Future appropriations will be applied to dredging the 9-foot channel from the outer harbor to the steamboat dock, and in prolongation of the 6-foot channel near the head of the harbor.

The commerce of Greenwich Harbor consists of coal, building materials, stone, and general merchandise. The improvement is designed to facilitate the transportation of this freight, which previous to the commencement of work could only be done at high water.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1894	....	3 to 7	40 to 300	110,000	....	....
1897	....	3 to 14	40 to 750	198,500	88,500	....

The reported value of this commerce for 1897 was $5,432,500. Statistics for 1898 or 1899 have not been received.

July 1, 1899, balance unexpended	$878.15
July 1, 1900, balance unexpended	878.15
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	14,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 16.)

EXAMINATION AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. Smith S. Leach, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. G. L. Gillespie, Corps of Engineers:

1. *Survey and estimate of cost of improving harbor of New London, Conn.*—Major Leach submitted report dated January 27, 1900, with plan for improvement at an estimated cost of $145,000, and $1,000 annually for maintenance. In his opinion, concurred in by the division engineer, the locality is worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 392, Fifty-sixth Congress, first session. (See also Appendix E 17.)

2. *Examination and plan and estimate for improving Milford Harbor, Connecticut.*—Major Leach submitted reports dated May 8 and December 28, 1899, respectively. He presents a plan for improvement at an estimated cost of $15,000, and $500 annually for maintenance. In his opinion, concurred in by the division engineer, the locality is worthy of improvement to the extent proposed. The reports were transmitted to Congress and printed in House Doc. No. 280, Fifty-sixth Congress, first session. (See also Appendix E 18.)

EXAMINATION OF BRANFORD HARBOR, CONNECTICUT, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Branford Harbor, Connecticut,* required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS IN NEW YORK ON LONG ISLAND SOUND, ON THE SOUTHERN SHORE OF LONG ISLAND, AND OF HARLEM AND EAST RIVERS, NEW YORK.

This district was in the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, to February 7, 1900, in the temporary charge of Maj. W. L. Marshall, Corps of Engineers, from February 8 to May 18, 1900, and in the charge of Maj. E. H. Ruffner, Corps of Engineers, since May 18, 1900. Division Engineer, Col. G. L. Gillespie, Corps of Engineers, since February 8, 1900.

1. Port Chester Harbor, New York.—This harbor, situated at the boundary between the States of New York and Connecticut, consists of the tidal part of Byram River and of a bay at its mouth opening into Long Island Sound.

The depth in the river before improvement was 1 foot, mean low water, and Salt Rock in the river and Sunken Rock in the bay were considered to be dangerous obstructions. Range of tide, 7.4 feet.

In 1872 a project for improvement was adopted, which, as subsequently modified in 1884 and 1888, consisted in removing Salt Rock to 9 feet below mean low water, in building a breakwater from Sunken Rock to Byram Point, and in dredging a channel from 60 to 100 feet wide and 2½ feet deep, mean low water, from the bay to the vicinity of the Port Chester wharves. Estimated cost, as revised, $57,000. This project has been completed, except some dredging in the upper harbor, at a cost of $52,000.

In 1899 a new project was adopted, providing for a channel to be 12 feet deep, mean low water, and 70 feet wide from deep water in the bay up to Town Dock, and to be 9 feet deep, mean low water, and 60 feet wide from the latter place to the Steamboat Dock. Estimated cost, $25,000.

Up to June 30, 1899, $52,000 had been expended under the previous project and $36.03 under the present. Salt Rock had been removed to 9 feet depth; the breakwater from Sunken Rock to Byram Point had been completed, and a channel had been dredged up to Town Dock 8 feet deep, mean low water, and 75 feet wide; thence to the steamboat landing, 6 feet deep, mean low water, and 60 feet wide, and from the latter place to the head of navigation 2½ feet deep, mean low water.

The results of the work have been to admit vessels of greater draft than formerly and to provide them with shelter while waiting for high tide to go to the landings.

Under a contract for dredging and rock removal 50,076 cubic yards of material was removed from the harbor during the fiscal year 1900, resulting in the completion of the projected channel up to Town Dock and in carrying the 9-foot channel 60 feet wide for a distance of 2,400 feet above Town Dock. The estimate for 1902 contemplates further dredging where necessary to maintain projected depth and width of channel.

The maximum draft that could be carried at mean low water June 30, 1900, up to Town Dock was 12 feet; thence to the steamboat landing 6 feet, and above this place 2½ feet, over the shoalest parts of the channel.

The commerce of this harbor consists mainly of coal, building materials, manufactured goods, and farm produce, amounting in 1899 to 169,500 tons, valued at $6,256,000.

The following table shows the tonnage of commerce reported for this harbor for several years since 1885:

	Tons.		Tons.
1885	81,000	1896	114,749
1890	160,000	1897	118,950
1893	163,000	1898	140,000
1895	73,257	1899	169,500

No new lines of transportation have been reported as established since July 1, 1899.

July 1, 1899, balance unexpended		$24,963.97
June 30, 1900, amount expended during fiscal year		7,317.05
July 1, 1900, balance unexpended		17,646.92
July 1, 1900, outstanding liabilities	$3,277.10	
July 1, 1900, amount covered by uncompleted contracts	10,746.32	
		14,023.42
July 1, 1900, balance available		3,623.50
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix F 1.)

2. *Mamaroneck Harbor, New York.*—This harbor, situated on the north shore of Long Island Sound, consists of a narrow inlet opening into a shallow, broad bay.

Before improvement the channel to the old steamboat wharf, half a mile up the inlet, had a depth of 5 feet, mean low water, gradually decreasing to 1 foot at the upper wharves. Various rocks at or near the mouth of the inlet obstructed navigation.

The project for improvement, adopted in 1882, provided for the removal of one of the rocks to 4 feet depth and the five others to 7 feet depth and for dredging a channel 100 feet wide and 7 feet deep up to the old steamboat wharf, and thence to the village wharves 80 feet wide and 4 feet deep. Estimated cost, $43,000.

In 1899 the project was modified in so far as to omit the removal of the three outer rocks and to make the channel from the old steamboat wharf to the upper wharves 7 feet deep and 100 feet wide without changing estimated cost for completion.

Up to June 30, 1899, $25,022.97 had been expended. One rock had been removed to a depth of 4 feet and two others to a depth of 7 feet, mean low water, and a channel 60 feet wide and 6 feet deep, mean low water, had been dredged from deep water in the bay to the upper wharves.

The improvement has made the upper wharves accessible to vessels of greater draft and has also rendered navigation of the harbor safer and easier.

During the past fiscal year 22,677 cubic yards of mud, sand, gravel, etc., and one-half cubic yard of rock were removed from the improved channel, resulting in an increase of its depth to 7 feet, mean low water, and of its width to 90 feet from the 7-foot curve to the old steamboat dock and to from 70 to 80 feet above this place to the upper wharves, thus still further facilitating the access to the latter.

Further appropriations will be applied to work for deepening and widening channel to the upper wharves.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water was 7 feet.

The commerce of Mamaroneck Harbor consists of coal, building materials, and general merchandise, which in 1897 amounted to 51,673 tons, valued at $877,100, or about twenty times the cost of the contemplated improvement.

It was not practicable to obtain reliable commercial statistics for the calendar year 1899.

Commercial statistics for the years 1888, 1896, and 1897 are as follows:

	Tons.
1888	24,986
1896	29,095
1897	51,673

No new lines of transportation are reported to have been established since July 1, 1899.

July 1, 1899, balance unexpended	$6,977.03
June 30, 1900, amount expended during fiscal year	6,888.83
July 1, 1900, balance unexpended	88.20

Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 2.)

3. *Larchmont Harbor, New York.*—This harbor or bay, situated on the northwest shore of Long Island Sound, 4 miles distant from the New York City limits, is about half a mile wide and five-eighths of a mile long. It is exposed to easterly and southerly storms. Two submerged rocks (Umbrella Rock and Huron Rock) obstruct the entrance, which has a depth of 18 feet, mean low water, gradually diminishing toward the head of the bay. Range of tide is 7.4 feet.

The original project, adopted in 1890, contemplated the building of two breakwaters to protect the anchorage ground, one to extend from Umbrella Rock to Umbrella Point and the other from Huron Rock to Long Beach Point. Estimated cost, $105,000. The project was modified in 1899 and now consists in constructing a breakwater to extend southwardly for 1,440 feet from the 6-foot curve off Long Beach Point and in removing Huron Rock to a depth of 14 feet, mean low water. Estimated cost, $108,000.

Up to June 30, 1899, $5,034.93 had been expended; 74 feet of the Umbrella breakwater and 64 feet of the Huron breakwater had been built over the rocks to a height of 10 feet above mean low water.

These structures in their present length are no protection to the anchorage ground, but merely serve as beacons upon the rocks.

No material progress has been made on the breakwater contemplated to be built under the modified project.

Bids for the work were first opened June 12, 1899; the lowest was accepted, but the party who had submitted the same declined to enter into contract. The work was readvertised and a contract made September 26, 1899, with the lowest bidder for 88,000 tons of riprap stone at 51 cents per gross ton in place. Work under this agreement was commenced November 4 and suspended November 25, 1899, during which period 3,362 tons of stone was delivered. As the contractor failed to resume work his contract was annulled April 13, 1900, and proposals were again invited and opened May 28, 1900. The lowest bidder was the Anderson-Murphy Company, of New York City, and a contract was entered into with it June 8, 1900, for furnishing 83,000 gross tons of riprap stone in place at 54 cents per gross ton.

It is expected that work under this agreement will be commenced early in July, 1900.

The work remaining to be done here is completion of the breakwater now in course of construction and to remove Huron Rock to a depth of 14 feet, mean low water.

Larchmont Harbor has not much commerce. It is mainly used by the Larchmont Yacht Club and also by coasters and fishing vessels for night anchorage and for shelter against storms from the west to the northeast.

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$49,965.07
June 30, 1900, amount expended during fiscal year	279.72
July 1, 1900, balance unexpended	49,685.35
July 1, 1900, amount covered by uncompleted contracts	44,820.00
July 1, 1900, balance available	4,865.35
Amount (estimated) required for completion of existing project	58,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 3.)

4. *East Chester Creek, New York.*—Before improvement, this small tidal stream, emptying into Pelham Bay, was navigable at high tide for vessels drawing 7 feet, as far as Lockwoods, a distance of 2¼ miles. The range of tide is 7.1 feet.

The project for improvement, adopted in 1873, provided for a channel 100 feet wide and 9 feet deep, mean high water, from deep water in Pelham Bay to a point 3,000 feet above Lockwoods. Estimated cost $136,500, subsequently reduced to $124,000.

Up to June 30, 1899, $89,990.50 had been expended under the project, which is considered as completed. Vessels drawing 9 feet are able to go 3,000 feet above Lockwoods at high tide.

During the fiscal year 3,937 cubic yards of mud was removed from the creek along the dock front on the west side, beginning at a point

300 feet above Lockwoods, restoring this part of the channel for a width of 36 feet and a length of 1,000 feet upstream to the projected depth.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water, was 2 feet.

The channel is subject to shoaling.

The commerce of East Chester Creek consists mainly of coal, building materials, stone, and miscellaneous freight. It has largely increased since 1887, as shown in the following comparative table:

	Tons.		Tons.
1887	16,110	1894	137,268
1890	19,505	1896	94,928
1892	47,115	1898	193,920
1893	55,990	1899	286,428

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$1,009.50
June 30, 1900, amount expended during fiscal year	811.97
July 1, 1900, balance unexpended	197.53
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix F 4.)

5. *Bronx River, New York.*—The navigable part of this small stream, which empties into the East River north of Hunts Point, extends from the mouth to West Farms, a distance of 3 miles. At the latter place it is crossed by a dam.

The natural depth was 4 feet, mean low water, at the mouth, decreasing to less than 1 foot at the head of navigation, where the range of tide is about 6 feet.

The project for improvement, adopted in 1896, provided for making a channel by dredging and rock removal, 4 feet deep, mean low water, with a width of 100 feet at and near the mouth, decreasing to 50 feet at the head of navigation. Estimated cost $85,985.

Up to June 30, 1899, $10,213.48 had been expended. Three ledges in the lower part of the river had been reduced to a depth of 6 feet, where the previous depth was from zero to 2 feet at low tide.

The improvement had not yet far enough advanced to admit vessels of greater draft than formerly.

During the fiscal year 1900, 667 cubic yards of rock was removed, under a contract, from six ledges in the vicinity of Jones Dock and Westchester Avenue Bridge.

The result is a wider and deeper channel where rock has been removed.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water, from the mouth to Stephens Dock, a distance of about 2¼ miles, was 3 feet.

The work remaining to be done is dredging and rock removal.

The commerce of Bronx River consists principally of coal, lumber, building materials, manufactured goods, drugs for dyeing purposes, and ice, amounting in the calendar year 1899 to 171,300 tons, valued at $1,985,700.

The following table shows the amount of commerce reported since 1896:

	Tons.
1896	94,244
1897	139,310
1899	171,300

No new transportation lines are reported to have been established since July 1, 1899.

July 1, 1899, balance unexpended		$19,786.52
June 30, 1900, amount expended during fiscal year		3,897.94
July 1, 1900, balance unexpended		15,888.58
July 1, 1900, outstanding liabilities	$833.26	
July 1, 1900, amount covered by uncompleted contracts	9,135.04	
		9,968.30
July 1, 1900, balance available		5,920.28
Amount (estimated) required for completion of existing project		55,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix F 5.)

6. *Mattituck Harbor, New York.*—This harbor is a tidal inlet extending in a southerly direction from Long Island Sound to the village of Mattituck, Long Island, a distance of about 2 miles.

One mile above the mouth a tide milldam with gates has been built across the stream. The depth at the entrance, which is obstructed by a shifting sand bar, is from 1 to 2 feet, thence up to the milldam from 2 to 7 feet at low tide, and above the latter the depth is 6 feet at high tide. The range of tide outside the entrance is 4.8, and below the tide milldam but 2.2 feet.

The project adopted in 1896 provides for a channel to be 7 feet deep, mean low water, from the entrance to the dam, and 7 feet deep, mean high water, above the dam to the village, and to have a width of 80 feet, increased at the mouth to 100 feet; the entrance channel to be protected by parallel jetties. Estimated cost, $83,000.

No work has been done yet under this project and no money expended.

To carry out the project for improvement it will be necessary to first construct the riprap jetties to protect and confine the shifting entrance channel. This work was estimated to cost about $40,000; but as not more than $15,000 was available only part of one jetty could have been built, resulting in no benefit to navigation. For this reason it was decided to retain the funds until a sufficient sum would have been appropriated to complete at least one of the jetties.

Since this decision was made the price for riprap stone has declined considerably in the vicinity of New York, and under the prevailing conditions it is probable that the funds on hand will be sufficient to construct one of the jetties. A project for the expenditure of the available funds for such purpose was therefore submitted to and approved by the Secretary of War, June 5, 1900.

Proposals for the construction of the west jetty were invited June 28, 1900, to be opened July 30, 1900.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water was 1 foot.

The commerce of Mattituck Harbor consists of farm produce and fertilizers, amounting in 1890 to about 3,000 tons.

The greater part of the local freight is shipped and received by rail, as under the present condition the harbor can be navigated only by boats of very light draft.

No new lines of transportation have been reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$15,000.00
July 1, 1900, balance unexpended	15,000.00
July 1, 1900, outstanding liabilities	16.84
July 1, 1900, balance available	14,983.16
Amount (estimated) required for completion of existing project	68,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	18,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 6.)

7. *Port Jefferson Harbor, New York.*—This harbor, situated on the north shore of Long Island, is a large and deep inland bay connected with Long Island Sound by a narrow entrance or inlet.

Before improvement the channel depth outside the entrance was but 4 feet, mean low water, whereas the depth in the harbor was 12 feet and more at low tide up to within 300 feet of the wharves of Port Jefferson village.

Range of tide at extrance, 7 feet; at village wharves, 6.2 feet.

Under a project of improvement adopted in 1871 and completed in 1883, two jetties had been built to protect the inlet, one on its east side, 1,390 feet long, and the other on its west side, 940 feet long, and a channel 8 feet deep, mean low water, and 100 feet wide had been dredged through the inlet and the shoal outside. Cost, $79,000.

A new project, adopted in 1890 and modified in 1894, provided for a channel through the entrance to be 200 feet wide and 12 feet deep, mean low water, the same to be protected by extending and enlarging the jetties already built. Estimated cost, $145,000.

Up to June 30, 1899, $49,227.48 had been expended under the present project. Both jetties had been partly enlarged and the entrance channel had been made 10 feet deep, mean low water, for a width of 200 feet, and 12 feet deep, mean low water, for a width of from 160 to 180 feet.

The improvement has resulted in facilitating navigation through the entrance channel and in allowing larger-draft vessels to enter the harbor.

Under a contract for strengthening and enlarging the jetties at the harbor entrance, 7,253 gross tons of riprap stone was delivered during the fiscal year 1900, of which amount 5,480 tons was placed in the west jetty and the remainder in the east jetty.

The former is now completed, being 940 feet long, 4 feet wide on top, and raised 4 feet above high-water level, except at the outer part, which for a length of 60 feet is made 6 feet above that level. The east jetty was widened and raised for a length of 128 feet north and south of the light-house, but is still in an unfinished condition.

The enlargement of the jetties resulted in a better protection of the entrance channel.

The maximum draft that could be carried June 30, 1900, over the shoalest part, at mean low water, was 12 feet.

The commerce of this harbor consists mainly of coal, building materials, farm produce, shellfish, and general merchandise, amounting in 1899 to 42,130 tons, valued at $2,145,940. The harbor is largely used as a winter anchorage for yachts.

The following statement shows the amount of commerce reported since 1890:

	Tons.		Tons.
1890	42,325	1896	31,700
1892	47,000	1897	25,497
1893	46,000	1898	24,976
1894	42,000	1899	42,130
1895	36,000		

No new lines of transportation are reported to have been established since July 1, 1899.

July 1, 1899, balance unexpended		$8,272.52
June 30, 1900, amount expended during fiscal year		3,876.77
July 1, 1900, balance unexpended		4,395.75
July 1, 1900, outstanding liabilities	$3,429.60	
July 1, 1900, amount covered by uncompleted contracts	487.03	
		3,916.63
July 1, 1900, balance available		479.12
Amount (estimated) required for completion of existing project		87,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		24,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix F 7.)

8. *Huntington Harbor, New York.*—This harbor is a narrow tidal estuary extending inland from Huntington Bay, L. I., in a southerly direction, for a distance of about 2 miles.

Before improvement it had a natural available depth of nearly 8 feet, mean low water, for a stretch of 1¼ miles from the entrance southward, thence gradually decreasing to zero toward the head of the harbor. Mean rise of tide 7.2 feet.

Under project of 1872 an extension of the 8-foot channel, 150 feet wide, was made to the old town dock at an expense of $22,500; this channel completely filled up again.

The present project, adopted in 1890, provides for dredging and maintaining a channel 8 feet deep and 100 feet wide, up to the upper wharves and to be protected by piling, if necessary. Estimated cost $32,000.

The expenditures under the present project up to June 30, 1899, amounted to $22,033.43. A channel had been dredged 8 feet deep, mean low water, 175 feet wide up to the bend at old town dock, 230 feet wide at the bend and 100 feet wide for 200 feet above the bend, a total length of about 3,500 feet. This improvement enables vessels to reach the landings without waiting for tides.

The operations during the past fiscal year consisted in removing 48,478 cubic yards of material from the west side of the channel, restoring it to the projected depth of 8 feet, mean low water, and widening it about 25 feet.

The estimate for 1902 contemplates completion and maintenance of projected channel.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water was 8 feet.

The commerce of the harbor consists mainly of coal, farm produce, building materials, and miscellaneous freight, amounting in the calendar year 1899 to 46,500 tons, valued at $605,000, as compiled by Mr. James M. Brush, of Huntington, N. Y.

The following table shows the variations in reported tonnage of commerce for several years since 1890:

	Tons.		Tons.
1890	39,500	1895	70,000
1892	44,000	1896	73,350
1893	46,000	1897	23,584
1894	58,000	1899	46,500

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$7,466.57
June 30, 1900, amount expended during fiscal year	7,455.63
July 1, 1900, balance unexpended	10.94
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	2,500.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 8.)

9. *Glencove Harbor, New York.*—This harbor is a small tidal inlet on the east side of Hempstead Harbor, Long Island. Its channel is about 2 feet deep at mean low water, and a bar at the entrance has a foot less depth. Before the improvement was made, vessels waiting for tides to enter the harbor were exposed to storms from the north and northwest.

The original project for the improvement, adopted in 1888, provided for a riprap breakwater extending from the northwest corner of Glencove Dock in a west-southwesterly direction for a distance of about 2,500 feet, the top to be 5 feet wide and 3 feet above mean high water. Estimated cost, $201,960. This project was modified in 1895, reducing length of breakwater to about 2,000 feet and the estimated cost to $135,000.

The expenditures for this improvement up to June 30, 1899, amounted to $62,835.94, resulting in the construction of 1,465 linear feet of the projected breakwater, which serves as a shelter to vessels waiting for rise of tide to enter the inner harbor, and as a protection to local shipping at Glencove Dock.

Mean rise of tides is 7.7 feet.

No work was in progress during the fiscal year. A light was maintained upon the unfinished end of the breakwater at a small expense.

To complete the breakwater to its projected length will require its extension 545 feet.

The commerce of Glencove Harbor consists chiefly of coal, corn, starch, glucose, building materials, and miscellaneous freights, the value of which is estimated to be about 45 times the cost of the completed improvement.

Following is a statement of the amounts of commerce for a number of years since 1889:

	Tons.		Tons.
1889	301,429	1897	733,400
1893	305,000	1899	About the same as 1897
1896	106,435		

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$164.06
June 30, 1900, amount expended during fiscal year	164.06

Amount (estimated) required for completion of existing project	72,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 9.)

10. Flushing Bay, New York.—Before improvement the controlling depth in the channel up to Flushing was 3.9 feet, mean low water.

The original project, adopted in 1879, provided for the building of 16,700 feet of diking to create a tidal basin intended to fill and discharge through the main channel, thus maintaining a least channel depth of 6 feet, mean low water, after once dredging. Estimated cost $173,500. The project was modified in 1888, omitting part of the diking, and again in 1891, limiting the same to one dike on the west side of the channel, 4,663 feet long, besides dredging and maintaining a channel 6 feet deep, mean low water, up to the lower bridge at Flushing.

Up to July 1, 1899, $122,495.53 had been expended; 4,663 linear feet of diking had been built and a channel 100 feet wide and 6 feet deep, mean low water, had been dredged in different places repeatedly.

The improvement has resulted in making the water front more accessible at every stage of the tide, and in permitting vessels of larger draft to use the channel.

No work was in progress during the past year.

Future appropriations should be applied to maintaining the dredged channel.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water was 6 feet.

The principal articles of commerce are coal, building and paving materials, dyewoods, logwood extracts, and farm produce, amounting in 1899 to 158,755 tons, valued at $1,534,937, nearly nine times the cost of the improvement.

The following is a statement of the amounts of commerce reported for Flushing Bay during the several years since 1888:

	Tons.		Tons.
1888	229,235	1896	80,820
1894 (partial returns)	46,942	1897	163,395
1895	150,376	1899	158,755

No new transportation lines are reported to have been established since July 1, 1899.

July 1, 1899, balance unexpended	$504.47
July 1, 1900, balance unexpended	504.47

Amount (estimated) required for completion of existing project	50,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix F 10.)

11. East River, New York.—East River is a tidal strait extending from the Battery, New York Harbor, to Throgs Neck, Long Island Sound, a distance of about 16 miles. Before improvement it was much obstructed by rocks and reefs, especially in the part known as Hell Gate.

The range of tide below (south of) Hell Gate is from 4½ to 5 feet, and east of that place from 5 to 7 feet.

The original project for improvement, adopted in 1867, provided for the removal to 26 feet, mean low water, of various rocks and reefs obstructing the channel in and near Hell Gate, and also for the construction of sea walls and dikes where necessary to guide the tidal currents. Estimated cost, $4,689,820.

The project was enlarged in subsequent years to include the removal of other rocks and reefs at different places between the Battery and Baretto Point, to depths varying from 18 to 26 feet, mean low water. The revised estimated cost of the project, as enlarged in 1868 and 1874, was $5,139,120, to which was added in 1899 $500,000, the estimated cost for removing Man-o-war Rock to a depth of 26 feet, mean low water, or a total of $5,639,120 for the enlarged project. In 1900 the removal of two small rocks, one off Third street and the other off Twenty-sixth street, Borough of Manhattan, to a depth of 19 and 26 feet, mean low water, respectively, was included in the project without revising the total estimated cost.

Up to June 30, 1899, $4,387,180.24 had been expended under the revised project. At that time a dike connecting Great and Little Mill rocks had been built and many of the rocks and reefs included in the project had been reduced to the projected plane below mean low water, or had been partly removed, as shown by the following table:

Name of locality.	Distance from Battery.	Least original depth, mean low water.	Least depth mean low water, June 30, 1899.	Projected depth.
	Miles.	*Feet.*	*Feet.*	*Feet.*
Diamond Reef	¼	17	26	24
Reef off Diamond Reef	¼	19	26	26
Coenties Reef	¼	14.3	25.5	24
Rock off 3d street	3	15.9	15.9	19
Shell Reef, off 9th street	3½	7.5	*a* 18	18
Pilgrim Rock, off 19th street	4	12	24	24
Rock off 26th street	4¼	16.1	16.1	26
Ferry Reef, off 34th street	4½	7	24	26
Charlotte Rock, off 34th street	4½	14.7	26.5	26
Man-o-war Rock	4¾	+ 0.8	+ 0.8	26
Middle Reef, including Flood Rock, Gridiron, Hen and Chickens, and Negro Heads	7	+ 6	18 to 20	26
Hallets Point	7¼	+ 4	26	26
Heel Tap	7½	12.1	20.5	26
Frying Pan	7½	11	18	26
Pot Rock	7½	20	22.8	26
Way Reef	7½	17.4	26	26
Shell Drake	7½	18.3	26	26
Scaly Rock	7½	....	26	26
Negro Point	7½	....	....	26
Reef off Sunken Meadow	9	11	17.8	18
North Brother Island Reef	10	16	26	26
Reef off Baretto Point	11	17	24	24

a Nearly.

A sea wall had also been built on "Bread and Cheese" by the authorities of New York City.

The improvement has resulted in a wider and straighter channel, making navigation much safer and easier.

The contractor for the removal of Man-o-war Rock has been engaged in drilling and blasting since the commencement of January, 1900, but up to the close of the fiscal year no rock had been removed.

Some obstructions to navigation which an examination showed to exist on Middle Reef were removed during January, 1900, to a clear depth of 18 feet below mean low water, the level of the surrounding bottom.

In accordance with approved project, specifications were prepared for the removal of the two small reefs off Third street and off Twenty-sixth street, respectively, and submitted for approval.

Future appropriations will be applied to rock removal.

The traffic on the East River is of very great extent, and is intimately connected with that of New York Harbor proper. But it is impracticable to obtain reliable statistics to show what proportion properly belongs to the East River, especially as the heavy coastwise traffic passing through this waterway is carried on in vessels which do not enter or clear at the custom-house.

July 1, 1899, balance unexpended	$248,099.09
June 30, 1900, amount expended during fiscal year	8,723.27
July 1, 1900, balance unexpended	239,375.82
July 1, 1900, amount covered by uncompleted contracts	159,000.00
July 1, 1900, balance available	80,375.82
Amount (estimated) required for completion of existing project	1,003,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 11.)

12. *Harlem River, New York.*—The Harlem River and Spuyten Duyvil Creek, both included in the improvement, are two waterways which join at Kingsbridge, N. Y., and separate Manhattan Island from the mainland. The narrow channel at their junction was obstructed by a ledge of rocks, awash at low tide.

Before improvement the Harlem River had an available depth of 10 feet, mean low water, from the East River to Morris Dock, except at High Bridge, where it was only 6 feet. From Morris Dock to Fordham Landing there was a crooked channel 7 feet deep, and above the latter place the river could only be used by the smallest class of vessels.

Spuyten Duyvil Creek from Kingsbridge to the Hudson had a depth of 4 feet, mean low water.

The range of tide in the Harlem River was from 5½ to 6 feet and in the creek and Hudson River 3.8 feet.

The original project for improvement, adopted in 1875 and modified in 1879 and 1886, provided for a continuous channel from the East River to the Hudson River 400 feet wide and 15 feet deep, mean low water, except just north of High Bridge, where the width was reduced to 375 feet, and in the rock cut through Dyckman Meadow, which was to be made 350 feet wide and 18 feet deep, mean low water. Estimated cost, $2,700,000.

Act of Congress approved March 3, 1899, contained a clause authorizing the disposal of the stone stored on land near Spuyten Duyvil, New York.

Up to June 30, 1899, $1,141,985.38 had been expended.

A channel not less than 150 feet wide and 12 feet deep, mean low water, had been made from the East River to the Hudson River. The rock cut had been completed, and 2,181 linear feet of crib and pile revetment and 770 linear feet of retaining wall had been constructed for the protection of the slopes.

The benefits which commerce has derived from the improvement are the reduced cost of transportation between different points on the Hudson, Harlem, and East rivers, due to a more direct connection and a deeper channel, and the increase in the local traffic, stimulated by the extension of the available water front.

During the fiscal year 1900 the contractor for the purchase and removal of the stone stored on land near Spuyten Duyvil, New York, removed 11,097 cubic yards of the same, making a total, under his contract, of 11,493 cubic yards. On November 25, 1899, he suspended work, and not resuming operations again, his contract was annulled May 3, 1900. The question of disposal of the stone to the best advantage of the United States is under consideration.

A change in the location of the drawspan of the railroad bridge across the mouth of Spuyten Duyvil Creek, which is in course of reconstruction, necessitated a shifting of the channel to the southward. This work was estimated to require the removal of 150,000 cubic yards, and a contract for dredging this amount was entered into December 11, 1899, with P. Sanford Ross, Incorporated.

Under the provisions of this contract 132,174 cubic yards of material was removed during the fiscal year, resulting in making a channel to near the new draw 400 feet wide and 15 feet deep, mean low water.

Dredging through the draw had to be postponed until the bridge is completed.

The increased width of the draw and of the approaching channel will greatly benefit navigation.

The maximum draft that could be carried, June 30, 1900, over the shoalest part at mean low water was 12 feet.

The channel is to be further deepened and widened by dredging and rock removal.

The commerce of the river is very large and steadily increasing. It consists mainly of general merchandise, grain, flour, feed, lumber, building materials, coal, ice, etc., amounting in 1895 to over 7,500,000 tons, valued at more than $203,000,000.

It was impracticable to obtain complete commercial statistics for the calendar year 1899. The freight received and shipped during that year via Harlem River by the New York, New Haven and Hartford Railroad Company alone amounted to 4,474,687 tons, as per statement received from its comptroller.

No new lines of transportation are reported to have been established since July 1, 1899.

July 1, 1899, balance unexpended		$103,014.62
June 30, 1900, amount expended during fiscal year		18,977.31
July 1, 1900, balance unexpended		84,037.31
July 1, 1900, outstanding liabilities	$2,497.42	
July 1, 1900, amount covered by uncompleted contracts	1,853.90	
		4,351.32
July 1, 1900, balance available		79,685.99
Amount (estimated) required for completion of existing project		1,455,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix F 12.)

13. *Newtown Creek, New York.*—Before improvement this small tidal stream extending from the eastern part of Brooklyn to the East River, opposite Thirty-fourth street, New York City, a distance of about 4 miles, had a depth of 12½ feet, mean low water, at the mouth, decreasing to 4 feet at the head.

The original project adopted in 1880, and as subsequently modified in 1884, provided for a channel 240 feet wide and 21 feet deep mean low water, from the mouth up to Vernon Avenue Bridge, thence up to head of navigation on both branches for a channel decreasing from 175 to 100 feet in width and from 18 to 10 feet in depth. Estimated cost $255,500.

In 1896 the project was again modified, providing for a uniform channel 125 feet wide and 18 feet deep, mean low water, from the mouth of the creek to the head of navigation at Metropolitan avenue. Estimated cost, $450,000.

At the time the latter project was adopted there was a depth of 21 feet mean low water at the mouth of the creek, gradually decreasing to 10 feet at head of navigation. Cost of improvement, $197,500.

Up to June 30, 1899, $196,349.77 had been expended under the modified project of 1896. At that time the channel had been dredged 125 feet wide and 18 feet deep, mean low water, from Vernon avenue to within 50 feet of Metropolitan avenue on the East Branch, and to the pier guard of the Metropolitan Avenue Bridge over the West Branch (the upper limits of the project), except in the immediate vicinity of Vernon Avenue Bridge and in the west drawspan of Greenpoint Avenue Bridge. The sharp bends above Meeker avenue have been widened by from 20 to 40 feet to preserve the channel depths.

The project is practically completed, but the channel is subject to shoaling.

The increased width and depth of the waterway has greatly facilitated navigation of the stream, permitting also the employment of larger vessels for commercial purposes.

The amount expended during the fiscal year ending June 30, 1900, was to pay outstanding liabilities, including bill for removing wreck encountered during dredging and the expenditures required in examination of dredged channel, etc.

The available funds will be applied in widening the channel at the entrance and in removing shoal spots wherever necessary.

The maximum draft that could be carried, June 30, 1900, over the shoalest part at mean low water was 18 feet.

The commerce of the creek is very large and consists chiefly of coal, building materials, petroleum and its products, chemicals, etc. It was not practicable to obtain reliable statistics for the calendar year 1899.

Commercial statistics, in tons, for the years 1896 and 1897 are as follows:

	Tons.
1896	2,740,482
1897	3,228,544

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$16,650.23
June 30, 1900, amount expended during fiscal year	964.62
July 1, 1900, balance unexpended	15,685.61
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix F 13.)

14. Wallabout Channel, New York.—This channel separates Cob Dock, an island in Wallabout Bay, from Brooklyn, N. Y. It is divided into two parts, called east and west channel, respectively, by a stone causeway which connects the island with the navy-yard. The east channel, the part under consideration, had an original depth of from 15 to 20 feet along the line of deepest water, diminishing to 5 feet along the sides. Mean range of tide 4.5 feet.

The project, adopted in 1899, consists in making the channel from the East River to the causeway 20 feet deep, mean low water, with widths ranging from 230 to 350 feet. Estimated cost, $40,000.

Up to June 30, 1899, $297.76 had been expended. At that time dredging over about one-quarter of the area to be improved had been completed.

During the fiscal year 122,308 cubic yards of mud, sand, gravel, etc., and 50 tons of large bowlders were removed from the channel (the former by contract, the latter by hired labor), resulting in the completion of the improvement as contemplated.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water, was 20 feet.

The improvement has made the docks accessible to many vessels which formerly had to be lightened to enable them to go there even at high tide.

The channel is subject to shoaling.

The commerce of Wallabout Channel is considerable, and believed to be increasing, but no complete data are on hand. It consists chiefly of coal, sugar, sirups, ice, lumber, and produce, amounting in 1897 for the first four items alone to 340,300 tons, valued at $16,008,000.

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$39,702.24
June 30, 1900, amount expended during fiscal year	17,875.93
July 1, 1900, balance unexpended	21,826.31

(See Appendix F 14.)

15. Canarsie Bay, New York.—This bay forms the northwest part of Jamaica Bay, at Canarsie Landing. The original depth, from the landing to Big Channel, was 4.2 feet, and to Island Channel 1.3 feet, mean low water. Rise of tide, 4.7 feet.

The original project of 1880—for the construction of dikes only—was subsequently modified to include both diking and dredging, with a view to securing a channel 100 to 150 feet wide and 6 feet deep, mean low water, connecting Canarsie Landing with Big Channel in Jamaica

Bay. It was afterwards enlarged, providing also for a south channel 4 feet deep from the landing to Island Channel, and a channel southeasterly to Gophel Channel 5 feet deep and 50 feet wide. The estimated cost is $88,000.

Up to June 30, 1899, $64,472.23 had been expended; 1,058 feet of diking had been built on the north side of the channel and 820 feet on the south side; the main channel had been dredged 6 feet deep, mean low water, for its full width and length; a channel 5 feet deep and 50 feet wide had been dredged to connect with Gophel Channel on the northeast, and another 4 feet deep to connect with Island Channel on the southwest.

Shipping has been benefited by the increased depth to the landing, as it obviates the delay waiting for tides.

No work was in progress during the fiscal year.

Future appropriations should be applied mainly to keeping the dikes in repair and to maintaining the dredged channels.

The maximum draft that could be carried June 30, 1900, over the shoalest part, at mean low water, was 6 feet in the main channel and 3 feet in the South Channel.

The commerce of Canarsie Bay consists mainly of building materials, fertilizers, fish, and coal.

It was not practicable to obtain reliable statistics for the calendar year 1899.

The following is a statement of amounts of commerce reported for several years since 1890:

	Tons.		Tons.
1890	50,898	1894	133,425
1892	67,510	1895	148,564
1893	69,510	1896	50,087

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	[1]$527.77
June 30, 1900, amount expended during fiscal year	2.85
July 1, 1900, balance unexpended	524.92
Amount (estimated) required for completion of existing project	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix F 15.)

16. Browns Creek, New York.—This narrow stream, which empties into Great South Bay, Long Island, near Browns Point, had a natural depth of from 1 to 3 feet at low tide, a bar at the mouth having less than 1 foot.

The project for improvement adopted in 1890 provided for a channel 100 feet wide and 4 feet deep, mean low water, to extend from deep water in the bay up to Sayville highway bridge, and to be protected at the entrance by jetties on both sides. Estimated cost, $46,000.

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[1] Erroneously given as $529.41 in Annual Report for 1899.

Up to June 30, 1899, $25,000 had been expended; 492 feet of the west jetty and 438 feet of the east jetty had been built, and a channel 100 feet wide and 4 feet deep, mean low water, had been dredged to within 2,400 feet of the highway bridge. The channel is subject to shoaling.

The improvement affords shelter for oyster and fishing boats employed in the vicinity.

Operations during the fiscal year consisted in removing 15,727 cubic yards of material from the channel, resulting in restoring it to the projected dimensions for a length of 2,000 feet, beginning at a point opposite the outer ends of the jetties and extending up the creek.

The maximum draft that could be carried June 30, 1900, over the shoalest part at mean low water was 4 feet.

The project provides for further extension of the jetties and additional dredging.

The commerce of Browns Creek consists principally of coal, brick, lumber, fish, and shellfish, amounting in 1899 to 11,642 tons, valued at $251,350.

The following statement shows the amount of commerce reported since 1897:

	Tons.
1897	9,180
1898	10,700
1899	11,642

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$3,000.00
June 30, 1900, amount expended during fiscal year	2,536.55
July 1, 1900, balance unexpended	463.45
Amount (estimated) required for completion of existing project	18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix F 16.)

17. Patchogue River, New York.—Before improvement this small inlet, extending from Great South Bay, Long Island, to the village of Patchogue, had a natural depth of about 2 feet; rise of tide, 1 foot.

The project for improvement adopted in 1890 provided for a channel 5,000 feet long (approximately), 60 feet wide, and 6 feet deep, mean low water, to be protected at its mouth against westerly storms by a jetty 1,700 feet long. Estimated cost, $40,000.

Up to June 30, 1899, $39,293.15 had been expended. At that time the jetty was completed and the channel dredged to its projected dimensions from Great South Bay up to within 70 feet of the established harbor lines. For 300 feet at the upper end the channel was made 100 feet wide, as a turning basin for vessels. The project is completed, but the channel is subject to shoaling.

The improvement enables vessels of 6 feet draft to reach the channel opposite the docks at ordinary tides without lightening.

No operations were in progress during the past fiscal year.

The maximum draft that could be carried, June 30, 1900, over the shoalest part at mean low water was 6 feet.

The commerce of Patchogue River consists mainly of lumber, coal, fish, shellfish, and miscellaneous merchandise, amounting in 1899 to 266,800 tons of an estimated value of $3,808,500, or about 95 times the cost of the improvement.

The following is a statement of the amounts of commerce of the river reported since 1890:

	Tons.		Tons.
1890	56,000	1896	143,500
1892	120,000	1897	250,000
1893	125,000	1898	255,200
1894	145,000	1899	266,800
1895	129,485		

No new lines of transportation are reported as established since July 1, 1899.

July 1, 1899, balance unexpended	$706.85
July 1, 1900, balance unexpended	706.85
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	3,700.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix F 17.)

18. Removing sunken vessels or craft obstructing or endangering navigation.—(*a*) *Wreck of schooner Richard Hall.*—This vessel was sunk October 1, 1898, in Long Island Sound, off Port Chester Harbor, New York.

The wreck being an obstruction to navigation, an agreement for its removal to 25 feet below mean low water was made; cost, $150. The wreck has been partly removed.

(*b*) *Wreck of canal boat Gettysburgh in Harlem River, New York.*—This wreck was lying in the Harlem River near the foot of Park avenue, Mott Haven, New York City.

Being a menace to navigation its removal was authorized by the Secretary of War July 10, 1899. The wreck was totally removed in July, 1899, at a cost of $243.

(See Appendix F 18.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer and reports thereon submitted:

1. Preliminary examination of Port Chester Harbor, New York.—Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, submitted report dated September 13, 1899. The locality is now under improvement by the United States, and in the opinion of Lieutenant-Colonel Benyaurd, concurred in by me, it is not worthy of further improvement than that contemplated by the existing project. The report was transmitted to Congress and printed in House Doc. No. 59, Fifty-sixth Congress, first session. (See also Appendix F 19.)

2. *Preliminary examination and plan and estimate for improvement of New Rochelle Harbor and Echo Bay, New York.*—Lieutenant-Colonel Benyaurd submitted reports dated September 16 and December 9, 1899, respectively. In his opinion, that portion of the locality known as New Rochelle Harbor is not worthy of improvement by the General Government, but Echo Bay is worthy. A plan is therefore presented for improvement of Echo Bay at an estimated cost of $17,000. The reports were transmitted to Congress and printed in House Doc. No. 235, Fifty-sixth Congress, first session. (See also Appendix F 20.)

3. *Preliminary examination and plan and estimate for improvement of Westchester Creek, New York.*—Lieutenant-Colonel Benyaurd submitted reports dated September 15 and November 28, 1899, respectively. He considers the locality worthy of improvement by the General Government, and presents a plan for improvement at an estimated cost of $42,780, and $2,000 annually for maintenance. The reports were transmitted to Congress and printed in House Doc. No. 111, Fifty-sixth Congress, first session. (See also Appendix F 21.)

4. *Preliminary examination and survey of Diamond Reef and Coenties Reef, East River, New York.*—Report on preliminary examination, dated April 22, 1899, by Maj. H. M. Adams, Corps of Engineers, and report on survey, dated February 28, 1900, by Maj. W. L. Marshall, Corps of Engineers, were submitted through Col. G. L. Gillespie, Corps of Engineers, Division Engineer. A plan for improvement at an estimated cost of $1,897,500 is presented, and in the opinion of the local officer, concurred in by the division engineer, improvement to the extent indicated is worthy of being undertaken by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 495, Fifty-sixth Congress, first session. (See also Appendix F 22.)

5. *Preliminary examination of Bay Shore, Long Island, New York, with a view to constructing a breakwater.*—Lieutenant-Colonel Benyaurd submitted report dated September 20, 1899. In his opinion, concurred in by me, the locality is not worthy of improvement by the General Government in the manner indicated. The report was transmitted to Congress and printed in House Doc. No. 43, Fifty-sixth Congress, first session. (See also Appendix F 23.)

6. *Preliminary examination of Patchogue River, New York, with a view to deepening the channel from Fire Island Inlet to Patchogue to a depth of 8 feet and width of 80 feet.*—Lieutenant-Colonel Benyaurd submitted report dated September 19, 1899. It is his opinion, in which I concur, that the work proposed is not worthy of being undertaken by the General Government. The report was transmitted to Congress and printed in House Doc. No. 133, Fifty-sixth Congress, first session. (See also Appendix F 24.)

7. *Preliminary examination and plan and estimate for improvement of Patchogue River, New York.*—Lieutenant-Colonel Benyaurd submitted reports dated September 19 and December 4, 1899, respectively. He presents a plan for improvement by enlarging the existing chan-

nel at an estimated cost of $19,550, and $2,000 annually for maintenance, to which extent he considers the locality worthy of improvement by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 171, Fifty-sixth Congress, first session. (See also Appendix F 25.)

8. *Preliminary examination of Sag Harbor, New York.*—Major Adams submitted report dated June 1, 1899, through the division engineer. A survey being deemed unnecessary, a plan for improvement is presented for construction of a breakwater at an estimated cost of $71,000. In the opinion of Major Adams the locality is worthy of improvement to the extent proposed, and his views are concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 77, Fifty-sixth Congress, first session. (See also Appendix F 26.)

9. *Preliminary examination of Three-mile Harbor, Long Island, New York.*—Major Adams submitted report dated May 20, 1899. It is his opinion, concurred in by the division engineer, and by me, that the locality is not worthy of improvement by the General Government under existing conditions. The report was transmitted to Congress and printed in House Doc. No. 62, Fifty-sixth Congress, first session. (See also Appendix F 27.)

EXAMINATION OF FIRE ISLAND INLET, IN GREAT SOUTH BAY, TO PATCHOGUE RIVER, NEW YORK, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Fire Island Inlet, in Great South Bay, to Patchogue River, New York,* required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF NEW YORK HARBOR, OF BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS, AND OF GOWANUS CREEK CHANNEL, NEW YORK.

This district was in the charge of Maj. H. M. Adams, Corps of Engineers, to November 16, 1899, in the temporary charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, from November 16, 1899, to January 8, 1900, and in the charge of Maj. W. L. Marshall, Corps of Engineers, since January 8, 1900, the officers in charge having under their immediate orders Lieut. James F. McIndoe, Corps of Engineers, and Lieut. James A. Woodruff, Corps of Engineers, the entire year, and Lieut J. J. Morrow, Corps of Engineers, to August 27, 1899. Division Engineer, Col. G. L. Gillespie, Corps of Engineers, to November 16, 1899, and since January 8, 1900.

1. *New York Harbor, New York.*—Before the improvement of the main entrance into New York Harbor was undertaken by the United States the least depth in mid-channel on the outer bar was 23.7 feet at mean low water, and about the same across three other shoals between the bar and deep water in the harbor. A large proportion of the commerce of the port, carried in vessels of great draft, could cross these shoals only at or near high water.

The project for the improvement of Gedney Channel was approved by the Secretary of War December, 1884, and extended to cover the whole of the main entrance to the harbor December, 1886. It provided for dredging a channel 1,000 feet wide and 30 feet deep at mean low water from deep water below the Narrows through the Main Ship and Gedney channels to deep water outside the bar. The estimated cost was $1,490,000 for dredging 4,300,000 cubic yards. The actual amount dredged to October, 1891, when the work was approximately completed, was 4,875,079 cubic yards.

Up to June 30, 1899, $1,821,440.29 had been expended. The projected channel had been completed and, since 1891, maintained by removing shoals and by widening.

During the past fiscal year the shoal at the south end of Main Ship Channel was removed out to the line of the range buoys on the west side, and small shoals in the upper part of the same channel have been deepened. The result has been to greatly ease the sharp turn from Main Ship Channel into Bayside Channel, where, under unfavorable conditions of tide and wind, large vessels often struck the bottom.

The maximum draft which could be carried through the entrance channels into the inner harbor June 30, 1900, was 30 feet at mean low water.

The river and harbor act of 1899 provided for maintaining the existing channels in New York Harbor and also for further improving the harbor by making a deep channel 2,000 feet wide and 40 feet deep at mean low water from the Narrows across the bar and to the open sea by way of Ambrose Channel (formerly known as East Channel). Under authority of this act of Congress a project was adopted and a contract entered into for the excavation estimated as necessary to complete the entire work. Of the $1,000,000 appropriated by this act the sum of $61.26 had been expended up to June 30, 1899.

As there was no suitable and sufficient plant for such work in existence in this country, the contract was so drawn as to allow the contractor twelve months in which to build a plant before beginning dredging. Unexpected delays were caused by the condition of the iron market in 1898–99, and the dredging plant is not yet quite completed. It is expected to be ready to begin excavation the latter part of this calendar year.

The foreign exports and imports for the port of New York during the year ending December 31, 1899, amounted approximately to 11,000,000 tons, valued at $1,111,329,687, being an increase over the valuation in 1886, before the improvement was begun, of $271,052,998. The entire cost of improvement of New York Harbor up to date is about two-thirds of 1 per cent of the increase in annual value of foreign commerce of the port since the improvement began and is less than one-sixth of 1 per cent of the value of the present foreign commerce per year.

No statistics are kept of the local and coastwise domestic commerce.

The outstanding liabilities reported in the accompanying money statement for Ambrose Channel represent the purchase of a vessel and outfit for conducting work of survey and inspection under continuing contract.

GENERAL IMPROVEMENT.

July 1, 1899, balance unexpended	$101,584.23
June 30, 1900, amount expended during fiscal year	39,102.98
July 1, 1900, balance unexpended	62,481.25
July 1, 1900, outstanding liabilities	2,184.96
July 1, 1900, balance available	60,296.29
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	37,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and habor act of 1899, and of sundry civil act of June 4, 1897.

AMBROSE CHANNEL.

July 1, 1899, balance unexpended		$999,938.74
June 30, 1900, amount expended during fiscal year		588.70
July 1, 1900, balance unexpended		999,350.04
July 1, 1900, outstanding liabilities	$12,333.33	
July 1, 1900, amount covered by uncompleted contracts	3,825,000.00	
		3,837,333.33
Amount (estimated) required for completion of existing project		3,000,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 1.)

2. *Channel in Gowanus Bay: Bay Ridge, Red Hook, and Buttermilk channels, in the harbor of New York.*—These channels lie along the east shore of the Upper Bay, New York Harbor, and, in the sequence named, form an eastern channel between the Narrows and the East River, separated from the main channel by a broad shoal off the mouth of Gowanus Bay and by Governors Island. The lower part of this waterway, consisting of Bay Ridge and Red Hook channels, had a natural low-water depth of 7 to 12 feet; Buttermilk Channel had a natural depth of 26 feet in a narrow, crooked channel, with Buttermilk and Red Hook shoals on either side.

Prior to 1896 this improvement was carried on under two separate projects, one for improving Buttermilk Channel, adopted in 1880 and modified subsequently so as to provide for the removal of Buttermilk and Red Hook shoals to 26 feet depth at mean low water, at an estimated cost of $529,000, and one for improving Gowanus Bay channels, adopted in 1881 and subsequently modified so as to provide for dredging Bay Ridge Channel 800 feet wide and 26 feet deep, Red Hook Channel 400 feet wide and 26 feet deep, dredging the triangular area between these channels to the same depth, and making Gowanus Creek Channel 250 feet wide and 21 feet deep, at a total estimated cost of $1,124,400.

Up to June 30, 1899, $496,350 had been expended upon Buttermilk Channel and $641,100 upon the Gowanus Bay channels. Buttermilk

Shoal, at the upper end of Buttermilk Channel, had been removed to 26 feet depth at mean low water, and 600 feet had been removed from the northwest side of the Red Hook Shoal to the same depth; the Bay Ridge Channel had been made 375 feet wide and 21 feet deep, with a depth of 26 feet for 175 to 200 feet of this width, and the Red Hook Channel had been made 350 feet wide and 21 feet deep, with 26 feet depth for 200 feet of this width.

By the terms of the river and harbor act of 1896 these works were consolidated and a small improvement of Gowanus Canal was added, and the project of 1896, so adopted, consisted in dredging channels of 26 feet depth at mean low water, with widths as follows: For Bay Ridge Channel, 800 feet; for the triangular area between Bay Ridge and Red Hook channels, maximum width, 900 feet; for the Red Hook Channel, 400 feet; for Buttermilk Channel at Red Hook Shoal, 1,000 feet, and for dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge to the extent of $5,000; at a total estimated cost of $837,300.

June 30, 1899, the project of 1896 had been completed; the amount expended under it was $625,854.47, which with $42,165.58 outstanding liabilities made the total cost of work done under the project $668,020.05.

The river and harbor act approved March 3, 1899, contained the following provision:

> Improving Bay Ridge Channel and Red Hook Channel in the harbor of New York: Continuing improvement, one hundred thousand dollars: *Provided*, That the work shall be begun at the forty-foot curve at the southerly end of Bay Ridge Channel, and be continued through it along the Brooklyn shore to Twenty-eighth street until the said Bay Ridge Channel shall have a uniform depth of forty feet at low tide and a width of one thousand two hundred feet, and the improvement of the Red Hook Channel shall be begun on its southerly end and at its junction with the Bay Ridge Channel, and be continued through it to its junction on its northerly end with the Buttermilk Channel until said Red Hook Channel shall have been made to a depth of forty feet at low tide and a width of one thousand two hundred feet: *And provided further*, That contracts may be entered into by the Secretary of War for the completion of said Bay Ridge Channel and Red Hook Channel, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate two million four hundred thousand dollars, exclusive of the amount herein and heretofore appropriated.

During the past fiscal year proposals were received for the excavation estimated as necessary to complete the above-described channels, and under date of July 31, 1899, a contract for the entire work was entered into which involved the removal of about 22,000,000 cubic yards of material at a rate of 10 cents per cubic yard, measured in scows. The contractors have undertaken building a new plant for this work which, it is expected will be ready to begin excavation in the fall of 1900.

The commerce of this part of New York Harbor consists of coal, grain, lumber, iron, and other freight, amounting in 1899 to 19,881,825 tons, valued at $764,708,971. The amount of commerce in transit through these channels can not be estimated.

The improvement already made has resulted in making these channels available for vessels of much greater draft than formerly. The maximum draft which could be carried through these channels June 30, 1900, was 26 feet at mean low water.

The outstanding liabilities reported in the accompanying money statement represent the purchase of a vessel and outfit for conducting work of survey and inspection under continuing contract.

BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS.

July 1, 1899, balance unexpended	$54,145.53
June 30, 1900, amount expended during fiscal year	46,883.07
July 1, 1900, balance unexpended	7,262.46
July 1, 1900, outstanding liabilities	2,743.00
July 1, 1900, balance available	4,519.46

BAY RIDGE AND RED HOOK CHANNELS.

July 1, 1899, balance unexpended		$100,000.00
Amount appropriated by sundry civil act approved June 6, 1900		262,000.00
July 1, 1900, balance unexpended		362,000.00
July 1, 1900, outstanding liabilities	$6,166.67	
July 1, 1900, amount covered by uncompleted contracts	2,200,000.00	
		2,206,166.67

Amount (estimated) required for completion of existing project	2,138,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	284,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 2.)

3. *Gowanus Creek Channel, New York Harbor.*—That part of Gowanus Creek improved under the title of Gowanus Creek Channel is the part from the foot of Percival street on the east to the junction of Red Hook and Bay Ridge channels on the west.

Before improvement Gowanus Creek Channel had an available low-water depth of about 11 feet.

In 1881 a project for improvement of the several channels in Gowanus Bay was adopted which, as subsequently modified, provided for making a depth of 21 feet at mean low water in the Gowanus Creek Channel, with width extending to the harbor lines on either side. This was accomplished in 1893, under parts of appropriations made for the several channels, of which it is estimated that about $75,000 was applied to Gowanus Creek Channel.

Up to July 1, 1896, about $75,000 had been expended on this work. The channel had been made 21 feet deep at mean low water to the harbor line on either side, and the project was completed.

Under the terms of the river and harbor act of 1896 a project was adopted for making the Gowanus Creek Channel 26 feet deep at mean low water between the foot of Percival street and Red Hook Channel, at a total estimated cost of $70,000.

Up to July 1, 1899, $24,047.35 had been expended under this project and the channel through the creek, from Red Hook Channel up to the foot of Percival street, a distance of 3,000 feet, had been dredged to 26 feet depth at mean low water for 125 feet width.

During the past fiscal year the 26-foot channel has been widened under contract, making it about 250 feet wide at the lower (southwest) end and about 175 feet wide at the upper end. The contract is very nearly completed. The part of the channel dredged in 1896 has shoaled from 2 to 3 feet by deposit of fine silt.

The maximum draft which could be carried through this channel June 30, 1900, was found along the sides recently dredged and was 26 feet at mean low water.

The commerce received in Gowanus Creek consists of coal, lumber, building materials, and miscellaneous goods, amounting to about 237,300 tons of freight in 1899, valued at $3,048,390. In addition, 2,041,980 tons of freight passed through Gowanus Creek Channel to and from Gowanus Canal, valued at about $20,000,000, making a total tonnage of 2,279,280 tons. The annual value of this commerce is about three hundred times the total cost of the present project.

The improvement has resulted in admitting to this channel vessels of 15 feet greater draft of water than formerly.

Following is a statement of the tonnage of commerce reported as received and discharged at the docks of Gowanus Creek, New York:

	Tons.
1895	366, 299
1896	220, 748
1897	215, 352
1899	237, 300

July 1, 1899, balance unexpended		$25, 952. 65
June 30, 1900, amount expended during fiscal year		18, 599. 55
July 1, 1900, balance unexpended		7, 353. 10
July 1, 1900, outstanding liabilities	$7, 065. 27	
July 1, 1900, amount covered by uncompleted contracts	260. 89	
		7, 326. 16
July 1, 1900, balance available		26. 94
Amount (estimated) required for completion of existing project		20, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		20, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 3.)

4. Removing sunken vessels or craft obstructing or endangering navigation.—(*a*) The British steamship *Alvena* sunk in New York Harbor, near the west end of Gedney Channel, after a collision on January 10, 1897. Removal was completed November 3, 1898. Payment, which was deferred pending a decision upon certain claims by the contractor regarding a penalty clause in the specifications, was made in July, 1899, after a decision was rendered.

(*b*) The three-masted barge *David Crockett* grounded and sunk on Flynns Knoll, near the entrance to New York Harbor, in February, 1899. To prevent her drifting into the channels, her removal was authorized and was accomplished in October, 1899, the broken hull and other parts being deposited in wreckage-yard back of the bulkhead line at Bayonne, N. J. The cost was $6,749.

(*c*) The canal boat *Daisy* sunk about July 14, 1899, and was found on the east side of the New York Harbor channel, about 1½ miles below Castle Williams, Governors Island. The cargo of coal was pumped out and, September 22, 1899, the hull was lifted bodily and deposited in wreckage-yards behind the bulkhead line at Weehawken, N. J., at a total cost of $479.

(*d*) *Wreck off the Battery, New York Harbor.*—This wreck was discovered by the United States Coast and Geodetic Survey, and was found to have a least depth of 16½ feet at mean low water, while the depth of surrounding bottom was about 30 feet. It lay on the north side of the channel off the South Ferry slip, and inshore from the usual course of deep-draft vessels.

Allotment for removal was made and in October, 1899, the wreck was lifted bodily and towed to Stapleton, Staten Island, where its cargo of coal was removed, and subsequently, November 18, 1899, the hull was sunk in deep water about two miles outside of Scotland lightship. No mark or means of identification was found upon the wreck. The cost of removal was $559.

(*e*) The three-masted schooner *Penokee*, coal laden, from Norfolk, Va., to Saco, Me., sunk during an easterly storm on the southwest bank of Swash Channel, New York Harbor. The wreck was removed November 14, 1899, and after taking out the cargo the vessel was found to be in condition to admit of repairing her for use. The cost of removal was $4,700.

(*f*) An obstruction in Gedney Channel, New York Harbor, was found by an Engineer survey party. It had least depth of 23.2 feet at mean low water, where the channel depth had been over 30 feet. The obstruction was removed November 7, 1899, and was found to consist of boiler, engine, shaft, and other iron work of a tugboat, the woodwork being destroyed. It is supposed to be the remains of the tugboat *Farrell*, sunk in that vicinity about twenty-five years ago. The cost of removal of the obstruction was $500.

(See Appendix G 4.)

EXAMINATION OF BUTTERMILK CHANNEL, NEW YORK HARBOR, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Buttermilk Channel, New York Harbor, with a view to obtaining a channel of the same width and depth as those contemplated by the project adopted for Bay Ridge and Red Hook channels*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS IN VERMONT, OF NARROWS OF LAKE CHAMPLAIN, NEW YORK AND VERMONT, OF HUDSON RIVER, NEW YORK, AND HARBORS THEREON, AND OF RIVERS AND HARBORS IN NORTHEASTERN NEW JERSEY.

This district was in the charge of Col. J. W. Barlow, Corps of Engineers.

1. Channel between North and South Hero islands, Lake Champlain, Vermont.—In its original condition this channel was obstructed at its west entrance by a bar through which the channel was but 40 feet wide and 7 feet deep, and at its east entrance by a bar through which the channel was 100 feet wide and 8 feet deep.

The project of August 11, 1888, was to dredge the channel at the two entrances to a width of 150 feet and depth of 10 feet.

At the close of the fiscal year ending June 30, 1896, $10,000 had been expended.

At that date there was a good channel at the east entrance of the depth and width prescribed in the project, but at the west entrance there was a troublesome bowlder in mid-channel and the channel was 1 to 2 feet shallower in the middle, 2 to 4 feet shallower at its edges, and 25 feet narrower than the project prescribed.

There have been no expenditures upon the improvement since September 30, 1889.

With the appropriation asked for the fiscal year ending June 30, 1902, it is proposed to complete the existing project by widening and deepening the channel to the limits authorized, and also remove the bowlder at the west entrance. This work will require the removal of about 4,000 cubic yards of bowlders, etc., at an estimated cost of $1 per cubic yard, the balance to be applied to engineering expenses.

Amount (estimated) required for completion of existing project........	$4,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1902.	4,300.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

2. *Harbor at Burlington, Vt.*—This harbor is situated on the eastern shore of Lake Champlain. In its natural condition ample depth of water existed along its docks and wharves, which were, however, unprotected from the severe storms crossing the lake. The greatest exposure was from the prevalent northwesterly gales, which had a sweep of 15 miles obliquely across it.

The original project for improvement, adopted in 1836, consisted in forming an artificial harbor in front of the city by constructing a breakwater parallel with the shore, and about 1,000 feet distant from the docks and wharves. Work commenced in 1836 and continued at intervals until 1857, when 1,069 linear feet of breakwater had been completed.

In 1867 a Board of Engineers, convened to consider the location and construction of breakwater, recommended that the one previously constructed be extended northward 1,500 feet. Of this extension 831 linear feet was built, and, in addition, 617 linear feet was added at the south end, making its total length 2,517 feet at the close of the fiscal year 1874.

In June, 1874, a plan was adopted for an extension northward of the breakwater, for a farther distance of 2,000 feet, the cost being estimated at $340,000. (See Annual Report of the Chief of Engineers for 1874, p. 275.)

In 1884 extensive repairs were begun to the portion of the breakwater built between 1836 and 1857.

By June 30, 1886, 3,560 linear feet of breakwater had been completed. On September 28 of that year a project was approved extending the breakwater 500 feet northerly and 1,000 feet southerly, keeping the line generally at a distance of from 800 to 1,000 feet from the line of the wharves.

August 24, 1894, a project was adopted which provided for replacing the decayed and dilapidated wooden superstructure of the breakwater with one of stone. (See Annual Report of the Chief of Engineers for 1895, p. 3237.)

The amount expended on this improvement to the close of the fiscal year ending June 30, 1899, was $595,388.63. With this amount 4,163 linear feet of breakwater, varying in width from 24 to 36 feet, had been built, thereby affording protection to a large portion of the docks and wharves, and 235 linear feet of wooden superstructure had been replaced by stone.

By June 30, 1886, 3,563 linear feet of breakwater had been completed at a cost of $501,811.07.

On September 28, 1886, a project was approved extending the breakwater 500 feet northerly and 1,000 feet southerly, keeping the line generally at a distance of from 800 to 1,000 feet from the line of the wharves, at an estimated cost of $150,000, and on August 24, 1894, the project was again amended so as to provide for replacing 3,803 linear feet of the decayed and dilapidated wooden superstructure of the breakwater with one of stone or concrete, at an estimated cost of $173,750 (see Annual Report of the Chief of Engineers for 1895, p. 3237), which made the total estimated cost of completing the work $323,750.

The amount expended on the present project to the close of the fiscal year ending June 30, 1899, was $93,577.56. With this amount 1,294 linear feet of wooden superstructure on old sections of the breakwater had been replaced by one of stone, and 600 linear feet of new breakwater, varying in width from 24 to 36 feet, had been built, in addition to that reported as completed on June 30, 1886, making the present total length of the breakwater 4,163 linear feet. This structure affords protection to nearly all the docks and wharves along the harbor front.

No work has been done on the breakwater during the past year, as arrangements to resume had not been completed until after the low-water season was over. Work will be commenced as soon as the lake is at a proper stage, and carried on vigorously to completion.

The unexpended balance is to be applied to replacing about 465 linear feet of decayed timber superstructure with one made of concrete, and the appropriation asked for fiscal year ending June 30, 1902, is to be applied to rebuilding about 1,650 linear feet of superstructure in the same manner.

In order to complete the project it will require the construction of 900 linear feet of breakwater and the rebuilding of about 2,030 linear feet of concrete superstructure.

The maximum draft that could be carried to the docks and wharves on June 30, 1900, was 11 feet at mean low water.

The principal items of commerce at this port are coal, lumber, stone, and general merchandise. The tonnage for 1897 was 109,180; for 1898, 116,527, and for 1899, 87,630.

July 1, 1899, balance unexpended	$15,172.44
June 30, 1900, amount expended during fiscal year	167.25
July 1, 1900, balance unexpended	15,005.19
July 1, 1900, amount covered by uncompleted contracts	12,500.00
July 1, 1900, balance available	2,505.19
Amount (estimated) required for completion of existing project	215,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 1.)

3. Otter Creek, Vermont.—This creek flows into Lake Champlain from its eastern shore. In its natural condition the channel was narrow and tortuous in places, and the available depth from Vergennes to the mouth, a distance of 8 miles, was less than 6 feet.

The original project, adopted in 1872, proposed the formation of a channel 100 feet wide and 8 feet deep from Lake Champlain to Vergennes, and also of a basin at this latter point, at an estimated cost of $58,146. (See Annual Report of the Chief of Engineers for 1872, p. 273.)

In 1882 the project was modified to provide for the removal of rock at steamboat landing, near Vergennes, which increased the cost to $73,748.40. (See Annual Report of the Chief of Engineers for 1882, p. 711.)

In addition, an annual expenditure, estimated at $1,000, will be required for maintenance after completion of the work.

The amount expended to June 30, 1899, was $61,500. The condition of the channel at that date was such as to allow boats drawing 7 feet of water to navigate between Lake Champlain and Vergennes during the entire season.

The work of the past year was partly in the nature of maintenance and consisted in redredging the basin at Vergennes in front of the nail company's dock and the steamboat wharf, at a cost of $1,000. This work increased the navigable depth from 7 to 8 feet.

The maximum draft that could be carried to Vergennes on June 30, 1900, was 8 feet at mean low water.

The sum of $3,000 can be profitably expended during fiscal year ending June 30, 1902, for continuing excavation of the authorized channel from Lake Champlain to Vergennes.

The commerce of this creek consists of coal, lumber, iron, kaolin, and general merchandise, and amounted in 1896 to 9,052 tons, in 1897 to 7,680 tons, and in 1899 to 7,200 tons.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	1,000.00
Amount (estimated) required for completion of existing project	11,248.00
Amount that can be profitably expended in fiscal year ending June 30, 1902.	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 2.)

4. *Narrows of Lake Champlain, New York and Vermont.*—In its original condition the 15 miles of this waterway, extending from the northern terminus of Champlain Canal at Whitehall northerly to Bensons Landing, Vt., had a very narrow and tortuous channel, not more than 9½ to 10 feet deep on the shoals at low water.

The original project, adopted in 1886, was to obtain a channel having a least width of 150 feet and depth of 12 feet at low water from the northern terminus of the Champlain Canal at Whitehall, N. Y., to deep water in Lake Champlain below Bensons Landing, Vt., a distance of 15 miles, at an estimated cost of $80,000. (See Annual Report of the Chief of Engineers for 1885, pp. 2312–2314.)

Work under this project was completed in September, 1889, at a little more than half its estimated cost, owing to the low prices paid for dredging.

In 1890 a supplemental project was prepared for widening and straightening the middle reaches of the channel at an estimated cost of $21,000. (See Annual Report of the Chief of Engineers for 1890, p. 2884.) This project was adopted in 1892 and work completed under it in August, 1896.

In 1896 a project was prepared for restoring, widening, and deepening the channel at an estimated cost of $22,500, the annual maintenance, after completion, being placed at $2,500. (See Annual Report of the Chief of Engineers for 1897, pp. 3302–3303.) This project was adopted in 1899.

To June 30, 1899, $63,500 had been expended. At that date the channel, which had previously been dredged to 12 feet, had shoaled in places, restricting the draft that vessels could carry through it to not exceeding 10 feet.

During the past year shoal places in Kenyons Bay, opposite Pulpit Point, and near the south end of the Narrows were redredged to a depth of 12 feet. This work increased the available depth for navigation from 10 to 12 feet.

The available balance is to be spent in making additions to guide booms, and the appropriation asked for fiscal year ending June 30, 1902, is to be applied to dredging about 90,000 cubic yards of material and in constructing and placing about 1,030 linear feet of fender timbers, thereby completing the work. An allotment of $1,500 from appropriation by emergency river and harbor act of June 6, 1900, was made for this work July 31, 1900.

The maximum draft that could be carried on June 30, 1900, was 12 feet at mean low water.

The tonnage passing through the Narrows consists of timber, pulp wood, salt, sugar, coal, stone, lime, clay, iron, and general merchandise, and amounted in 1897 to 579,873 tons, in 1898 to 498,731 tons, and in 1899 to 848,457 tons.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	4,925.91
July 1, 1900, balance unexpended	74.09
Amount (estimated) required for completion of existing project	17,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 3.)

5. *Hudson River, New York.*—The portion of this river to which improvements have been applied is the stretch beginning at the head of navigation at Troy and extending downstream, at first to New Baltimore, a distance of 20 miles, and later to Coxsackie, a farther distance of 8 miles. In its natural condition the navigable depth of the channel between Troy and Albany was 4 feet at mean low water, between Albany and New Baltimore 7½ feet, between New Baltimore and Coxsackie 11 feet, and below Coxsackie 12 feet or more, which was sufficient for purposes of navigation.

Prior to 1834, when the United States assumed charge of the improvement, work had been carried on by the State of New York, and consisted in the construction of jetties and dredging, which resulted in no permanent improvement of the river.

A Board of Engineers was convened in 1834 to examine into the different projects presented and to devise a plan, with estimates, for the improvement of the river. They recommended the construction of a system of longitudinal dikes and occasional dams, at an estimated cost of $819,634.10. The sum of $370,000 was expended under this project.

In 1852 an additional project was adopted, which consisted in dredging and closing island chutes, under which $50,000 was expended.

From 1854 to 1866 no work was done by the General Government.

On June 24, 1866, a project was adopted for the improvement of the river between New Baltimore and Troy, a distance of 20 miles, giving a navigable channel of 11 feet, at mean low water, from New Baltimore to Albany, and 9 feet from Albany to Troy, to be secured by dikes and dredging, and estimated to cost $862,297.75.

This estimate was increased in 1867 to $984,304.47; again in 1882 to $1,062,304.47, and in 1886 to $1,078,304.47. In 1887 it was considered that $255,000 would still be required to complete the improvement, and in 1889 this estimate was increased $295,000 over and above prior appropriations, which made the total estimated cost of the work $1,423,538. The amount expended under this project was $1,247,940.29.

The river and harbor act of September 19, 1890, provided for the appointment of a Board of Engineer Officers, whose duty it was to thoroughly examine the obstructions in the Hudson River and report a project and estimate for its improvement. The project, contained in the Board's report of October 1, 1891, was adopted by Congress in 1892. It provided for maintaining old improvements and constructing new regulation works between Coxsackie and New Baltimore; also for deepening the entire reach under improvement, so as to afford a channel 400 feet wide and 12 feet deep at mean low water from Coxsackie to the foot of Broadway, Troy, and thence 300 feet wide and 12 feet deep to the State Dam. The estimated cost of the work was $2,447,906.56, provided the entire work be completed within five years.

In 1898 an estimate was submitted to Congress which gave a detailed statement of the probable cost of completing this improvement, the amount being stated as $2,246,769.80, which brought the total cost of the work up to $4,694,676.36.

The river and harbor act of March 3, 1899, sanctioned the continuance of the work and at the same time authorized the Secretary of War to make such changes in the location and width of channel at and near Troy, as, in his opinion, the interests of navigation might require.

The project was accordingly amended so as to provide a 12-foot channel, 400 feet wide, from Coxsackie to the foot of Broadway, Troy, thence gradually decreasing in width to 150 feet opposite Jacob street, Troy, above which point the width was to remain at 150 feet as far as the State Dam. This change resulted in a saving of $350,813.36, which makes the total estimated cost of the work $4,343,863.

A history of the improvement of this river is contained in the Annual Report of the Chief of Engineers for 1885, page 677 et seq., and the report of the Board which formulated the last project may be found in the Annual Report of the Chief of Engineers for 1892, page 750 et seq.

The total amount expended to June 30, 1899, was $4,089,873.58, of which $1,667,940.29 was under former projects and $2,421,933.29 under the present one. With this money 36,722 linear feet of new dikes and shore revetments had been completed, 7,603 linear feet of old dikes had been rebuilt, 20,008 linear feet of old dikes had been refilled with rubblestone, rubblestone had been placed along the footing for the protection of 4,600 linear feet of paved dikes, 21,409 square yards of new paving had been laid under contract, 9,500 square yards of new paving had been laid and 29,534 square yards of old paving had been repaired by hired labor, 4,162,742 cubic yards of sand, gravel, cobblestones, clay, and bowlders, 190,988 tons of rock, and 20,116 tons of sand covering rock had been removed from the channel.

From Coxsackie to Albany there was a navigable channel not less than 11.5 feet deep, with a minimum width of 30 feet, except at Willow Island Shoal, where it was 10.5 feet deep, with a width of 400 feet, and in front of Castleton, where it was 11 feet deep, with a width of 100 feet. From Albany to foot of Broadway, Troy, the 12-foot channel had a least width of 100 feet, except at Round Shoal and Covills Folly, where it was 70 and 50 feet, respectively; through Bath Crossover the channel was only 10.5 feet deep, with a width of 200 feet, and in front of Watervliet Arsenal it was 11.5 feet deep for a width of 160 feet. At foot of Broadway, Troy, though there was 12 feet in the channel, only about 9 feet could be carried to the dock front. From the foot of Broadway to the State Dam at Troy the channel was only 5.5 feet deep, with a general width of 50 feet.

During the fiscal year contracts have been in force for constructing and repairing dikes, for furnishing rubble and paving stone, for removal of rock, and for dredging.

The expenditure during the past fiscal year was applied to the construction of 1,199 linear feet of new dike and the rebuilding of 9,912 linear feet of old dikes; to the relaying of 2,598 square yards of paving and the protection of the footing of 5,900 linear feet of paved dikes; to the refilling with rubblestone of 100 linear feet of old timber dikes; and to the dredging of 177,718 cubic yards of sand, gravel, cobblestones, clay, and bowlders from the channel.

As a result of work during the fiscal year, the depth at Willow Island Shoal has been increased from 10.5 to 12 feet and over for a width of 400 feet. At other bars the dredging was done to restore the depth, where, as a result of the ice dams during the past winter and spring, shoals so obstructive as to require immediate removal had been formed; this dredging is still in progress.

The channel between Coxsackie and Albany has generally maintained its depth; the slight changes in dimensions of the channel at different localities is given in the local officer's report.

The unexpended balance is to be expended as follows: $325,750 in dredging and rock removal, $106,750 in dike construction and repairs, and about $32,620 for engineering and contingencies of the work.

The appropriation asked for fiscal year ending June 30, 1902, is to be applied to dredging, rock removal, construction and repair of dikes, and engineering and contingent expenses of the work. One hundred and seventeen thousand dollars of this amount is already covered by existing continuing contracts, and the balance will be required to provide for new continuing contracts to be entered into.

The amount required to complete the work is to be expended in dredging, rock removal, and construction and repair of dikes; the exact quantity of each class of work can not be definitely stated at the present time, owing to changes which have occurred in the channel during time of freshets.

The maximum draft that could be carried June 30, 1900, at mean low water, as established in 1876, was 11 feet from Coxsackie to Albany, and 12 feet from Albany to Congress Street Bridge, at Troy, except over the Bath Cross-over, where there was only 10 feet. The effect of the deepening of the channel between Albany and Troy has been to lower the plane of mean low water at Troy from 0.5 to 0.9 of a foot and to increase the range of tides from 0.8 to 1 foot.

The amount of commerce within the limits of the improvements now in progress was more than 5,000,000 tons in 1899, with an estimated value of over $119,000,000, and consisted principally of merchandise, grain, lumber, fuel, building materials, and ice.

In addition to the local commerce a large amount of through commerce is carried.

July 1, 1899, balance unexpended		$157,363.55
Amount appropriated by sundry civil act approved June 6, 1900		400,000.00
		557,363.55
June 30, 1900, amount expended during fiscal year		92,243.64
July 1, 1900, balance unexpended		465,119.91
July 1, 1900, outstanding liabilities	$11,067.77	
July 1, 1900, amount covered by uncompleted contracts	524,409.72	
		535,477.49
July 1, 1900, balance needed for uncompleted contracts		70,357.58
Amount (estimated) required for completion of existing project		1,364,567.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		[1] 300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix H 4.)

6. *Saugerties Harbor, New York.*—This harbor is situated at the mouth of Esopus Creek, which empties into the Hudson River on its west shore, about 100 miles above New York City. The creek is from 180 to 500 feet wide, and is navigable for a distance of about three-quarters of a mile above its mouth.

The natural depth in the creek was 7 feet or more at mean low water; the entrance, however, was obstructed by a broad shoal, on which there was an available depth of only about 3 feet. The mean rise and fall of the tide is about 4 feet.

A project for improvement was adopted in 1884, but was slightly modified before work began in 1887. It consisted in securing a channel 300 feet wide and 8 feet deep, at mean low water, by constructing parallel dikes and dredging between them, the estimated cost of the work being $52,000. (See Annual Report of the Chief of Engineers for 1887, p. 662.)

The project was completed in 1892, at an actual cost of $42,000; subsequent expenditures have been applied to maintenance. The amount expended to June 30, 1899, was $54,316.90. The condition of the channel at that time was such that boats drawing 9 feet of water could navigate from the mouth to the steamboat dock.

Work during the past year consisted in filling the dikes with rubblestone wherever necessary. This expenditure has, therefore, resulted in no increase in depth or width of the channel in the harbor.

The unexpended balance is to be applied to maintenance whenever the necessity exists, and will be expended in dredging or dike repair, as may be deemed to be most expedient, and the appropriation asked for fiscal year ending June 30, 1902, is also for maintenance and is to be applied in the same manner.

The river and harbor act of March 3, 1899, provided for an examination and survey of Saugerties Harbor, "with a view of extending the improvement from the westerly end of the south dike westerly to the 'Point of Rocks;' also with a view to removing the loose rock from the channel, and continuing the depth of 12 feet, at low water, toward the head of the harbor." A report on such survey, with estimate of cost of work proposed, is printed in House Doc. No. 107, Fifty-sixth Congress, first session, and is submitted herewith as Appendix H 20. The estimates there given include improvement from the Hudson River to the steamboat docks.

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[1] Of this amount $100,000 is required for the completion of the work provided for under the existing continuing contract authorized by the river and harbor act approved March 3, 1899, and the remainder is to be applied to further work under the general project.

Attention is invited to the supplemental estimate of cost for continuing this improvement from the steamboat dock to within 600 feet of dam at head of harbor, submitted herewith in Appendix H 5.

The estimate submitted in House Doc. No. 107, Fifty-sixth Congress, first session, which provides for a channel 12 feet deep and 300 feet wide from the Hudson River to the steamboat landing at Saugerties, is $44,685. The supplementary estimate, which provides for extending an 8-foot channel above steamboat landing to the rapids below the dam on Esopus Creek and for dredging along wharf front on the west side of creek above steamboat landing, is $80,770, or a total estimate for this improvement of $125,455, and $3,000 per annum for maintenance.

The maximum draft that could be carried on June 30, 1900, was 9 feet at mean low water.

The commerce of this harbor consists mainly of bluestone, coal, building materials, and general merchandise, and amounted to 51,000 tons in 1897, to 58,368 tons in 1898, and to 50,800 tons in 1899.

July 1, 1899, balance unexpended	$2,683.10
June 30, 1900, amount expended during fiscal year	533.10
July 1, 1900, balance unexpended	2,150.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix H 5.)

7. *Harbor at Rondout, N. Y.*—This harbor is situated at the mouth of Rondout Creek, which empties into the Hudson River on its west shore, 90 miles above New York City, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, with mean rise and fall of tide of about 4 feet.

In 1871 the available depth of water in the harbor was 7 feet at mean low water, the result of improvements made by private parties.

In 1872 a project for improvement was adopted, which provided for securing a permanent channel 14 feet deep at mean low water, by constructing parallel dikes and dredging between them, at an estimated cost of $172,500. (See Annual Report of the Chief of Engineers for 1872, p. 811.) This project was completed in 1880 at a total cost of $90,000. Expenditures since then have been applied to maintenance.

The amount expended to June 30, 1899, was $114,324.20. The condition of the channel at that date was such that boats drawing 13 feet could navigate the harbor at all times.

The expenditure during the past year was applied to repairing the dikes wherever necessary, and has, therefore, resulted in no increase in depth or width of the channel in the harbor.

The maximum draft that could be carried on June 30, 1900, was 13 feet at mean low water.

The commerce of this harbor consists mainly of coal, cement, lime, bluestone, ice, and general merchandise, and amounted in 1896 to 2,333,050 tons, in 1897 to 2,330,000 tons, and in 1899 to 1,885,000 tons.

July 1, 1899, balance unexpended		$4,675.80
June 30, 1900, amount expended during fiscal year		2,617.16
July 1, 1900, balance unexpended		2,058.64
July 1, 1900, outstanding liabilities	$1,520.11	
July 1, 1900, amount covered by uncompleted contracts	525.53	
		2,045.64
July 1, 1900, balance available		13.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix H 6.)

8. Harbor at Peekskill, N. Y.—This harbor is a prominent indentation upon the eastern shore of the Hudson River, about 45 miles above New York City. It measures approximately 1 square mile east of the 12-foot contour of the river, and the outlying flats, 3,500 feet wide, have a maximum depth over them of 5 feet at mean low water. A narrow channel, 6 feet deep at mean low water, follows the shore from north to south past the town docks, which enables steamboats and small craft to transport by water a part of the commerce originating at the town.

The original project for this improvement, adopted by the river and harbor act of June 3, 1896, consisted in widening the channel along the wharf front to 100 feet and deepening it to 10 feet, also in extending it north and south until the deep-water channel in the Hudson River was reached. The estimated cost was $50,000.

The amount expended to June 30, 1899, was $10,122.74. The condition of the channel in the harbor at that time was such that boats drawing 9.5 feet of water could be brought to the wharves.

During the past year the channel in front of the wharves was dredged to a depth of 10½ feet and width of 150 feet, and the northerly and southerly connections with the Hudson River were dredged to a depth of 10½ feet and width of 100 feet, thereby completing the project at a cost of about two-fifths of the estimate. This was possible owing to the low price received for dredging at the last opening.

The commerce of Peekskill Harbor is increasing so rapidly that channels of the dimensions first decided on are no longer adequate. Navigation interests ask that a channel 200 feet wide and 15 feet deep be made along the wharf front, and that the connections north and south with the Hudson River have the same depth and a width of 150 feet. The present channel can be increased to those dimensions without increasing the estimated cost of the improvement, provided as reasonable a price for dredging be procured in the future as was had at the last letting.

The unappropriated amount of the estimate is $30,000, and can be applied to the proposed extension of project if authorized by Congress.

The maximum draft that could be carried to the wharves on June 30, 1900, was 10.5 feet at mean low water.

The commerce of this harbor consists of general merchandise, building material, iron ore, coal, iron, lumber, and molding sand, and amounted to 404,300 tons in 1897, to 734,950 tons in 1898, and to 1,092,455 tons in 1899.

July 1, 1899, balance unexpended	$9,877.26
June 30, 1900, amount expended during fiscal year	9,277.26
July 1, 1900, balance unexpended	600.00

(See Appendix H 7.)

9. *Passaic River, New Jersey.*—This river is a stream of considerable size, rising among the highlands in the northern part of New Jersey and flowing in a general easterly and southerly course into Newark Bay. It is navigable from its mouth to Passaic, a distance of about 16 miles. In its natural condition the navigable depth to Newark was about 7 feet at mean low water; from Newark to Passaic it was about 3 feet. The rise of the tide at the mouth is 4.7 feet, and at Passaic it is 2.5 feet.

The first project for improvement, adopted by the river and harbor act of June 10, 1872, was for providing a channel from Newark to Passaic from 6 to 7½ feet deep and from 50 to 200 feet wide, the cost being estimated at $123,924.

A subsequent project for improving the river below Newark was authorized by the river and harbor act of June 14, 1880, at an estimated cost of $353,875. It proposed a channel 200 feet wide and 10 feet deep at mean low water up to Center Street Bridge, Newark.

The two projects were consolidated by the river and harbor act of July 13, 1892, the estimated cost of the improvement being $547,697.

The amount expended to June 30, 1899, was $453,408.33, and was applied to constructing a dike at the head of Newark Bay, also several small dikes in the upper part of the river, and in dredging channels of the required width and depth at shoal places. The condition of the channel in the river at that date was such that a depth of 9.5 feet could be carried to Center Street Bridge, Newark, a distance of 8 miles; a depth of 7.5 feet to the Erie Railroad Bridge, a farther distance of 1 mile, and a depth of 5 feet to the city of Passaic, an additional distance of 7 miles.

The expenditure during the past year was applied to redredging the channel between the Plank Road and the Center Street bridges at Newark and in dredging at the Belleville Bar. The former channel was widened to 200 feet and deepened to 10 feet for a distance of 1,800 feet, the width previous to the dredging having been 100 feet. The unexpended balance will be applied to payments becoming due for dredging, rock removal, etc., under existing contract, and the appropriation asked for fiscal year ending June 30, 1902, will also be applied to same class of work.

The maximum drafts that could be carried on June 30, 1900, were as follows: 10 feet to the Center Street Bridge, Newark; 7.5 feet to the Erie Railroad Bridge, Newark, and 5 feet to Passaic.

The commerce of this river consists mainly of building material, iron ore, fertilizers, coal, and general merchandise, and amounted to 1,370,724 tons in 1897, to 1,509,772 tons in 1898, and to 1,962,462 tons in 1899.

July 1, 1899, balance unexpended	$14,941.67
June 30, 1900, amount expended during fiscal year	5,971.20
July 1, 1900, balance unexpended	8,970.47
July 1, 1900, amount covered by uncompleted contracts	8,500.00
July 1, 1900, balance available	470.47
Amount (estimated) required for completion of existing project	79,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	18,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 8.)

10. Channel between Staten Island and New Jersey.—This channel is an inland waterway, about 17 miles long, connecting New York Harbor with Raritan Bay. It consists of the Kill van Kull, connecting the upper bay with Newark Bay, and the Arthur Kill, connecting Newark Bay with Raritan Bay.

The natural depth through the channel was 15 feet or more at mean low water, except for a distance of about 1¾ miles in Newark Bay, where there was a shoal with a crooked channel 9½ feet deep. The mean rise of tide is about 5 feet.

The first project, adopted by the river and harbor act of June 23, 1874, was for making a channel from 14 to 16 feet deep through this shoal, at an estimated cost of $443,211. The only work done under it was the building of 2,237 linear feet of diking, at a cost of $50,000.

A second project was adopted in 1880, which, with subsequent modifications, consisted in dredging a channel through the shoal 400 feet wide and 14 feet deep at mean low water, the cost being estimated at $210,000.

A supplemental project was adopted by the river and harbor act of August 11, 1888, which had for its object the removal of the point of land known as Steep Point and straightening of the channel to the westward of the Baltimore and Ohio Bridge. The cost was estimated at $26,500.

This amendment brought the total cost of the improvement up to $286,500.

The river and harbor act of June 3, 1896, extended the project to include the dredging of a channel in Lemon Creek, on Staten Island, at a cost of $5,000.

The amount expended to June 30, 1899 (including $5,000 spent on Lemon Creek), was $258,507.23. The condition of the channel at that date was such that boats drawing 14 feet of water could navigate throughout its entire length during the whole year.

The work during the current year was in the nature of maintenance and consisted in redredging the channel around the sharp bend at the Corner Stake Light, where the width was increased from 200 to 400 feet for a distance of 1,500 feet, and, in addition, from 250 to 350 feet for a distance of 1,500 feet east and west of the 400-foot section. The unexpended balance will be applied to maintenance and will be expended in redredging the channel around the sharp bend at the Corner Stake Light. The appropriation asked for fiscal year ending June 30, 1902, is also intended for maintenance, and is to be applied to removing the material which washes into the channel from Newark Bay, and which is estimated to amount to from 100,000 to 200,000 cubic yards annually.

The maximum draft that could be carried June 30, 1900, through the Staten Island channel is 14 feet at mean low water.

The freight carried through this waterway consists of oil, coal, ores, clay products, chemicals, fertilizers, grain, machinery, manufactures, and general merchandise, and amounted in 1897 to 10,500,832 tons, in 1898 to 10,184,261 tons, and in 1899 to 11,311,991 tons.

July 1, 1899, balance unexpended	$32,992.77
June 30, 1900, amount expended during fiscal year	12,449.42
July 1, 1900, balance unexpended	20,543.35
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix H 9.)

11. *Elizabeth River, New Jersey.*—This is a small creek in the eastern part of New Jersey, which discharges into the Arthur Kill at Elizabethport. Its width varied from 50 to 90 feet, and it had a high-water depth of 4 feet at the head of navigation at Broad street, Elizabeth, 2⅝ miles above its mouth. The mean rise of tide at the mouth was 4.7 feet, and at Bridge street, Elizabeth, 3.4 feet.

The project, authorized by the river and harbor act of March 3, 1879, consisted in improving the river by dredging a channel 60 feet wide and 7 feet deep at mean high water to the head of navigation, at an estimated cost of $25,530, which was increased in 1881 to $43,160.

The amount expended to June 30, 1899, $43,160, was applied to dredging and redredging a channel 7 feet deep at mean high water and from 30 to 60 feet wide from the mouth to Bridge street, Elizabeth.

No work was done during the past fiscal year, owing to lack of funds.

The appropriation asked for fiscal year ending June 30, 1902, is to be applied to maintenance, it being estimated that at least 7,500 cubic yards of material washes into the channel annually which should be removed.

The maximum draft that could be carried to Bridge street, Elizabeth, on June 30, 1900, was 1 foot at mean low water and 4.4 feet at high water.

The commerce of this river consists of coal, building materials, and miscellaneous freights. It amounted to 21,650 tons in 1895, 36,066 tons in 1896, and 28,865 tons in 1897.

Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement	$2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix H 10.)

12. *Raritan River, New Jersey.*—This river is a moderate-sized stream flowing through the central part of the State of New Jersey and emptying into the Raritan Bay at Perth Amboy. It is navigable to New Brunswick, N. J., a distance of 12 miles, where it is the eastern terminus of the Delaware and Raritan Canal. The mean rise of tide at the mouth is 5.1 feet, and at New Brunswick it is 5.56 feet.

In its natural state the channel to New Brunswick was obstructed by several extensive shoals, on which the depth was from 6½ to 8½ feet at mean low water.

The project for improvement, adopted by the river and harbor act of June 18, 1878, provided for a channel 200 feet wide and 10 feet deep at mean low water from the mouth to the Delaware and Raritan Canal terminus at New Brunswick, to be obtained by dredging, diking, and rock excavation, the cost being estimated at that time at $2,093,662. Recent and more improved methods for doing such work have made it probable that this estimate will not exceed $1,026,500.

The amount expended to June 30, 1899, was $651,250. This expenditure resulted in the completion of four dikes and the partial completion of a fifth. A channel of the full depth, 10 feet, had been made to within 500 feet of the canal terminus, the lower 8½ miles being 200 feet wide and the balance 100 feet wide. These dimensions have, however, been considerably reduced during the suspension of operations, especially in the upper reaches of the river.

During the present year work consisted in extending the channel to the canal terminus at New Brunswick, a distance of 500 feet—the dimensions given were a depth of 10 feet and width of 100 feet—and in completing Dike C at the Middle Grounds.

The unexpended balance is to be applied to repairing dikes where needed, and the appropriation asked for fiscal year ending June 30, 1902, is to be applied to dredging, construction and repair of dikes, and construction of shore protection. To complete this project it will require 182,000 cubic yards of dredging, at 27½ cents; 222,000 cubic yards, at 44 cents; 35,000 cubic yards of rock removal, at $3.30; 7,500 linear feet of dike construction, at $6.60; 17,300 linear feet of dike repairs, at $2.20, and 1,000 linear feet of shore protection, at $4.40. If project is amended by reducing width of channel above Rocky Reach from 200 to 100 feet, which will be ample for the needs of commerce for many years to come, the item of rock removal can be omitted from the project for completion.

On June 30, 1900, the maximum draft that could be carried to the head of navigation was limited by gravel shoals below the rock cut to 8 feet at mean low water.

The commerce of this river consists principally of coal, ores, lumber, building materials, and general merchandise, and amounted in 1897 to 1,218,752 tons, in 1898 to 1.255,972 tons, and in 1899 to 1,523,391 tons.

July 1, 1899, balance unexpended	$20,000.00
June 30, 1900, amount expended during fiscal year	16,442.32
July 1, 1900, balance unexpended	3,557.68

Amount (estimated) required for completion of existing project	355,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of June 4, 1897.	

(See Appendix H 11.)

13. South River, New Jersey.—This is a small stream in the central part of New Jersey, which discharges into the Raritan River about 8 miles above its mouth.

A private canal about three-quarters of a mile long had been dredged from near Washington, on the South River, to Sayreville, on the Raritan River, which shortened the sailing course about 2 miles.

The depth in the canal was about 3.5 feet, and in the river about 2.5 feet as far as Old Bridge, at the head of navigation, 6.3 miles above the canal. The mean rise of tide at the canal is 5.34 feet and at Old Bridge 4.57 feet.

The first project, adopted by the river and harbor act of March 3, 1871, proposed dredging a channel 6 feet deep at mean low water up to the Washington wharves, at an estimated cost of $13,653. This was completed in 1874, at a cost of $20,000.

The present project, authorized by the river and harbor act of June 14, 1880, provided for correcting the canal outlet and for obtaining, by dredging and diking, a channel 100 feet wide and 8 feet deep to Washington, 1.5 miles above the mouth; thence 6 feet deep to Bissetts, 3.7 miles above the mouth; thence 4 feet deep to Old Bridge, 6.3 miles above the mouth, at the head of navigation. The cost was estimated at $194,695, but was reduced in 1892 to $176,975.

The amount expended on the present project to June 30, 1899, was $87,501.15. The condition of the river at that date was such that boats drawing 7 feet could navigate as far as the upper docks at the town of South River, N. J., passing through the canal cut-off; there was a depth of 6 feet to the docks at Lower South River, below the cut-off, and a depth of 5 feet as far up as the railroad bridge above the town.

Work during the present year was principally in the nature of maintenance, the channel having been widened and deepened so that there was a least depth available for navigation from the mouth to the Washington wharves of 7½ feet, a slight increase in depth over that of last year.

The appropriation asked for fiscal year ending June 30, 1902, is to be applied to dredging and to dike construction. To complete this improvement in accordance with project it will require the construction of about 10,400 linear feet of dikes and the dredging of at least 100,000 cubic yards of material.

The maximum draft that could be carried to South River on June 30, 1900, was 8 feet, and to the railroad bridge above 5 feet, at mean low water.

Large brickyards established along the banks of this river give it a commercial importance out of proportion to its size.

The commerce consists principally of brick, clay, coal, and general merchandise, and amounted in 1897 to 308,563 tons, in 1898 to 274,381 tons, and in 1899 to 343,202 tons.

July 1, 1899, balance unexpended	$5,498.85
June 30, 1900, amount expended during fiscal year	5,498.85
Amount (estimated) required for completion of existing project	83,975.00
Amount that can be profitably expended in fiscal year ending June 30, 1902.	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of June 4, 1897.	

(See Appendix H 12.)

14. Raritan Bay, New Jersey.—This bay is a large body of water lying between the southern end of Staten Island and the New Jersey shore. Its greatest width north and south is about 5 miles, and its greatest length east and west is about 7 miles. The Raritan River empties into it at its west end between Perth Amboy and South Amboy, and the Arthur Kill, or Staten Island Sound, extends northward, connecting it with Newark Bay.

This bay had naturally a fairly straight channel, 11 feet deep at mean low water, to South Amboy. The line of the deepest water, however, followed the Staten Island shore from Perth Amboy to Seguine Point, where it was separated from deep water in the eastern part of the bay by a shoal 1.5 miles broad, with a minimum depth of 14.5 feet. The mean rise of tide in the bay is 5 feet.

The river and harbor act of March 3, 1881, authorized a project for making a 21-foot channel, 300 feet wide, from Seguine Point to deep water in the bay, at a cost of $126,000. This amount was subsequently increased to $165,000 to provide for a channel of the same dimensions through the shoals off Wards Point. The act of September 19, 1890, extended the project to include a 15-foot channel, 300 feet wide, from South Amboy to deep water near Great Beds Light, the cost of the improvement being increased to $357,875. The act of June 3, 1896, again amended the project so as make this latter channel 21 feet deep instead of 15, at an additional cost of $150,000.

The present project, therefore, consists in dredging 21-foot channels at mean low water, 300 feet wide, from Seguine Point to deep water in the bay, through two shoals opposite Wards Point, and from South Amboy to deep water near Great Beds Light, at a total estimated cost of $507,875.

The amount expended to June 30, 1899, was $375,250. The Seguine Point and Wards Point channels had been dredged and redredged to a depth of 21 feet for a width of from 100 to 300 feet, but had shoaled again so that the greatest available depth was 19.5 feet. The South Amboy channel had been dredged to a depth of 15 feet for a width of 300 feet, and redredged to a depth of 21 feet for a width of from 100 to 150 feet, but had shoaled again so that the greatest available depth was 18 feet.

The expenditures during the past year were applied to redredging, widening, and deepening the Seguine Point and South Amboy channels. The former channel was excavated to a depth of 21 feet for a width of nearly 300 feet, and the latter channel to a depth of 21 feet and width of 300 feet.

Of the available balance, about $1,000 will be retained for future use in dredging, and the balance will be applied to contingent expenses connected with the work done during the year. With the appropriation asked for fiscal year ending June 30, 1902, it is proposed to dredge the channels to their full dimensions, which will require the removal of about 375,000 cubic yards of material; future work will consist only of maintenance, the cost of which is estimated at $20,000 per annum.

The maximum draft that could be carried June 30, 1900, through the Wards Point channel was 19.5 feet, and through the Seguine Point and South Amboy channels 21 feet, all at mean low water.

The commerce of the bay consists mainly of coal, brick, manufactures, and general merchandise, and amounted in 1897 to 4,852,075 tons, in 1898 to 5,552,474 tons, and in 1899 to 6,507,402 tons.

July 1, 1899, balance unexpended	$67,250.00
June 30, 1900, amount expended during fiscal year	66,064.45
July 1, 1900, balance unexpended	1,185.55
Amount (estimated) required for completion of existing project	65,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 13.)

15. *Matawan Creek, New Jersey.*—This creek is a small tidal stream in the eastern part of New Jersey, which discharges into Raritan Bay at Keyport Harbor. It is navigable up to the bridge of the New York and Long Branch Railroad, about 1⅞ miles above its mouth.

In its natural condition the mouth was obstructed by a mud flat, through which a narrow and crooked 3-foot channel existed. Above this flat there was a 4-foot channel for a mile, and beyond a narrow 3½-foot channel extending nearly up to the head of navigation at Matawan. The rise of tide is 4.9 feet.

The river and harbor act of March 3, 1881, authorized a project for improving this stream by dredging a 4-foot channel, 100 feet wide, from the mouth to Winkson Creek, about 1 mile, and thence 75 feet wide to the railroad bridge at Matawan, the estimated cost being $33,120.

The amount expended to June 30, 1899, was $39,154.79. The condition of the channel at that date was such as to allow vessels of 4 feet draft to reach Matawan at all times of the year.

During the present year the work was in the nature of maintenance and consisted in widening the channel so that it had a minimum width of 80 feet at the outlet into Keyport Harbor and a minimum width of 40 feet in the creek as far as Matawan.

The appropriation asked for fiscal year ending June 30, 1902, is to be applied to maintenance. It has been estimated that it will require the removal of about 10,000 cubic yards of material, which washes into the channel each year.

The maximum draft that could be carried June 30, 1900, was 4 feet at mean low water.

The commerce of this creek consists of brick, fertilizers, farm produce, and general merchandise, and amounted to 51,000 tons in 1899.

July 1, 1899, balance unexpended	$2,965.21
June 30, 1900, amount expended during fiscal year	2,965.21
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix H 14.)

16. *Keyport Harbor, New Jersey.*—This harbor consists of a bay about 1 mile broad on the south shore of Raritan Bay.

There was naturally no distinct channel in the harbor, the available depth to the wharves being less than 4 feet at mean low water. A 6-foot channel had been dredged at private expense before the United States assumed charge of the improvement, but it had shoaled again to 5 feet. The range of the tide is 4.9 feet.

The river and harbor act of August 2, 1882, adopted a project for dredging an 8-foot channel, 200 feet wide, from Raritan Bay to the steamboat dock, at a cost of $40,475.

The amount expended to June 30, 1899, was $42,999.75. The condition of the channel at that date was such that boats drawing 5 feet could reach the Keyport wharves at all times.

During the past fiscal year the existing channel between Raritan Bay and the steamboat dock at Keyport was given an increased width of 30 feet, the depth in which was 8 feet, thereby increasing the depth during the remainder of the boating season by 3 feet over that of the year before.

The appropriation asked for fiscal year ending June 30, 1902, is intended for maintenance. It has been estimated that the removal of about 15,000 cubic yards of material, which washes into the channel annually, will be required.

Owing to shoaling, the maximum draft that could be carried June 30, 1900, to the Keyport wharves was 7 feet at mean low water.

The commerce of this harbor consists mainly of farm products, fertilizers, coal, lumber, fish, shellfish, and miscellaneous freight, and amounted to 105,200 tons in 1896, to 109,100 tons in 1897, and to 67,500 tons in 1899.

July 1, 1899, balance unexpended	$2,475.25
June 30, 1900, amount expended during fiscal year	2,475.25
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix H 15.)

17. Shoal Harbor and Compton Creek, New Jersey.—This harbor is on the south shore of Raritan Bay, 5 miles from Sandy Hook; Compton Creek is a narrow stream emptying into it. The natural harbor is inside the mouth of the creek, where the depth is from 3 to 6 feet at mean low tide. The creek is navigable for one-quarter of a mile above its mouth, where it is crossed by a highway bridge without a draw.

The entrance to this harbor was obstructed by a broad flat shoal, on which there was a depth of less than 1 foot at mean low tide, the distance between the deep water in the creek and the 4-foot depth in the bay being about one-half mile. The mean rise of tide is 4.5 feet.

The plan for improvement authorized by the river and harbor act of September 19, 1890, proposed a channel 4 feet deep at mean low water, connecting Compton Creek with Raritan Bay, the width of which was to be 150 feet in the bay and 75 feet in and near the mouth of the creek, the channel through Shoal Harbor to be protected by a dike if necessary. The estimated cost of the work was $64,130.

The amount expended to June 30, 1899, was $16,087.52. The condition of the channel through Shoal Harbor and Compton Creek at that date was such as to allow vessels of 2 feet draft to navigate at low water.

During the past year a 4-foot channel 75 feet wide was dredged from the 4-foot contour in Raritan Bay to the 4-foot contour in Compton Creek, a distance of 2,600 feet. This work afforded navigation an increase in depth of 2 feet over that of the year before.

The appropriation asked for fiscal year ending June 30, 1902, is to be applied to widening and extending the channel previously dredged. To complete the improvement it will be necessary to dredge about 80,000 cubic yards of material.

The maximum draft that could be carried June 30, 1900, in the channel through Shoal Harbor and Compton Creek was 4 feet at mean low water.

The commerce of this locality, consisting of farm and fish products fertilizers, and general merchandise, amounted to 184,000 tons in 1897, to 194,500 tons in 1898, and to 226,000 tons in 1899.

July 1, 1899, balance unexpended	$7,912.48
June 30, 1900, amount expended during fiscal year	7,912.48
Amount (estimated) required for completion of existing project	40,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1902.	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H 16.)

18. *Shrewsbury River, New Jersey.*—This river is a large tidal basin in the eastern part of New Jersey, and consists of two bays, each having an area of about 3 square miles, and known as the North Branch, or Navesink River, and the South Branch. A channel, called the main stem, unites the two branches at their eastern ends and extends northwardly to the southeast end of Sandy Hook Bay.

Before any improvement was begun by the United States the available depth to Oceanic, on the North Branch, 5 miles above the mouth, was 3.5 feet; to Branchport, on the South Branch, 9 miles above the mouth, it was 2.5 feet. The mean rise of tide at the outer bar is 5 feet, at Highlands Bridge 3 feet, and at Seabright Bridge 1.3 feet.

A project was adopted by the river and harbor act of March 3, 1871, for dredging 6-foot channels through the shoal places in both branches of the river. This was completed in 1873 at a cost of $19,000. The channels, however, soon filled up after suspension of work.

The plan of improvement, adopted by the river and harbor act of March 3, 1879, provided for making 6-foot channels at mean low water, with widths from 150 to 300 feet, through the shoals in the main stem and both branches, by means of dredging and diking, at an estimated cost of $142,086. Owing to the necessity of frequent redredging, and to the fact that prices were higher than anticipated, the estimated cost was increased to $234,062.

In 1897 and 1898 it became necessary to dredge a channel west of Island Beach, as the improved channel east of it had been closed by sand carried into the river from the ocean through a break in the Sandy Hook Peninsula. This break has now been closed.

The amount expended to June 30, 1899, was $234,299.85. The condition of the channels at that date was such as to allow boats drawing 3 feet to navigate the main stem, boats drawing 6 feet to navigate the North Branch, and boats drawing 4 feet to navigate the South Branch.

The work done during the past year consisted in redredging the channel east of Island Beach, which was made 6 feet deep and 100 feet wide for a distance of 1,500 feet, thereby increasing the depth available for navigation in the main stem by 3 feet, and in redredging a channel in the North Branch, at upper Rocky Point, to a depth of 6 feet.

The maximum draft that could be carried June 30, 1900, in the main stem of the river was 3½ feet, in the North Branch 5½ feet, and in the South Branch 4 feet at mean low water.

The commerce of this river, consisting mainly of coal, farm produce, fertilizers, and general merchandise, amounted in 1897 to 896,600 tons, in 1898 to 1,003,000 tons, and in 1899 to 906,000 tons. The passenger traffic is important, the number of people carried in 1899 being 400,000.

The navigable channel in the main stem of this river was so filled up by sand from the ocean during the breach in the Sandy Hook Peninsula that it will take considerable money to restore it to its former condition. During the previous season steamboats were obliged to run on tides, and they will probably have to do so again this year. This resulted in quite a falling off in number of passengers and tons of produce carried. An allotment of $10,000 from appropriation by emergency river and harbor act of June 6, 1900, for dredging was made June 30, 1900.

With the available funds it is proposed to redredge the channel in the main stem and both branches of the river, it being probable that most of the money will be required for the main stem. The appropriation asked for fiscal year ending June 30, 1902, is to be applied to maintenance, it having been estimated that it will require at least that sum to keep the channels open.

July 1, 1899, balance unexpended	$9,700.15
Amount allotted from river and harbor act approved June 6, 1900	10,000.00
	19,700.15
June 30, 1900, amount expended during fiscal year	9,700.15
July 1, 1900, balance unexpended	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix H 17.)

19. Manasquan River, New Jersey.—This is a small stream in the eastern part of New Jersey, which empties into the Atlantic Ocean about 26 miles south of Sandy Hook.

In its natural condition the depth in the river for several miles above its mouth varied from 4 to 6 feet; the outlet, however, was obstructed by a shifting sand bar on which the depth did not exceed 1½ feet. After severe storms this outlet was sometimes entirely closed, remaining so until sufficient fresh water had accumulated in the river above to force an outlet into the ocean. The mean range of tide is 2.4 feet.

A project for improvement, adopted by the river and harbor act of March 3, 1879, contemplated obtaining a permanent outlet for the river nearly at right angles to the shore, with a depth of 6 feet at mean low water, also in dredging a channel in the lower river to the same depth. The estimated cost was $52,120.

The river and harbor act of September 19, 1890, appropriated $2,000 to be expended in the removal of obstructions placed by the Government at the mouth of the river, if, in the discretion of the Secretary of War, the same should be done. The removal of the obstructions alluded to was deemed unnecessary by the local engineer officer in charge, therefore no expenditure was made of these funds.

The river and harbor act of March 3, 1899, authorized a resumption of this work, a revised estimate of cost having been submitted June 30, 1898. It was then stated that it would require $18,300 in addition to funds on hand to complete the improvement, making the total cost $59,300.

The amount expended under this project to June 30, 1899, was $39,338.20. With this money two jetties had been constructed, but neither having been completed to full length, no permanent improvement was accomplished.

No work was done during the past year except to repair the north dike. This expenditure therefore resulted in no change in existing conditions. It was intended to commence the construction of the south dike; but as the prices bid for this work were so much higher than expected, it was found to be impossible to build with money available a sufficient length of the dike to produce any good result. It was therefore decided to retain the balance of the available funds until another appropriation shall have been made, with the expectation that better prices will be obtained for a greater amount of work. With the available funds and the appropriation asked for fiscal year ending June 30, 1902, it is proposed to construct the south dike and close small passageways, through which water escapes.

The maximum draft that could be carried June 30, 1900, was 2 feet at mean low water.

The commerce amounts practically to nothing. The river is used principally by pleasure craft during the summer season.

July 1, 1899, balance unexpended	$6,661.80
June 30, 1900, amount expended during fiscal year	736.80
July 1, 1900, balance unexpended	5,925.00
Amount (estimated) required for completion of existing project	13,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H 18.)

20. Removing sunken vessels or craft obstructing or endangering navigation.—1. The wreck *W. M. Whitney* burned and sunk in the Hudson River near New Baltimore, N. Y., forming an obstruction to navigation. The removal of the wreck was completed August 3, 1899.

2. The wrecks *Katie Watson* and *W. B. Hurd* sunk in the channel of Newark Bay, New Jersey, forming obstructions to navigation. The wrecks were removed and disposed of during November, 1899.

3. The wreck *R. G. Fairbanks* sunk in the channel of the Hudson River near Hudson, N. Y., forming an obstruction to navigation. The removal of this wreck was completed in May, 1900.

4. The wreck *Satanella* sunk in the channel of Raritan Bay, New Jersey, near the Old Orchard Shoal Light, forming an obstruction to navigation. The wreck is now being removed under contract entered into April 14, 1900.

5. The wreck *Pacific* sunk in the Hudson River, New York City, forming an obstruction to navigation. The wreck was removed and disposed of during April, 1900.

6. The wreck *G. W. Van Cleaf* sunk in the channel in Keyport Harbor, New Jersey, forming an obstruction to navigation. The wreck was removed and disposed of during May, 1900.

The total amount expended during the year in removal of wrecks was $1,993.77.

(See Appendix H 19.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Col. J. W. Barlow, Corps of Engineers, and reports thereon submitted:

1. *Preliminary examination with plan and estimate of cost of improvement of Saugerties Harbor, New York.*—Colonel Barlow submitted report dated June 24, 1899, with plan for improvement at an estimated cost of $7,465 and $2,000 annually for maintenance for extending existing improvement to Point of Rocks, and $44,685 and $2,500 annually for maintenance for a 12-foot channel from the Hudson to the steamboat landing at Saugerties. In his opinion, concurred in by me, the improvement is worthy of being undertaken by the General Government. The report was transmitted to Congress and printed in House Doc. No. 107, Fifty-sixth Congress, first session. (See also Appendix H 20.)

Colonel Barlow submits in his annual report upon improvement of this locality (Appendix H 5) a supplemental estimate of $125,455 and $3,000 annually for maintenance for improvement of this harbor and extending the channel up Esopus Creek to the rapids below the dam.

2. *Preliminary examination and survey of Tarrytown Harbor, New York.*—Colonel Barlow submitted reports dated June 16 and December 15, 1899, respectively. He considers the locality worthy of improvement by the General Government and presents two plans for improvement estimated to cost, respectively, $26,000 and $1,000, or $2,000 biennially, for maintenance for a 12-foot channel, and $55,000 and $1,000, or $2,000 biennially, for maintenance for a 15-foot channel. The reports were transmitted to Congress and printed in House Doc. No. 283, Fifty-sixth Congress, first session. (See also Appendix H 21.)

3. *Preliminary examination and survey of Arthur Kill, or Staten Island Sound, New York and New Jersey.*—Colonel Barlow submitted reports dated May 2, 1899, and January 25, 1900, respectively. He presents a plan for improvement at an estimated cost of $696,000 and $5,000 annually for maintenance, and states that in his opinion the project is worthy of being undertaken by the United States. The reports were transmitted to Congress and printed in House Doc. No. 393, Fifty-sixth Congress, first session. (See also Appendix H 22.)

4. *Preliminary examination and survey of Passaic River, New Jersey, up to Paterson.*—Colonel Barlow submitted reports upon preliminary examinations dated May 5 and November 13, 1899, and reports upon survey dated December 30, 1899, and January 31, 1900. There seems to be no question as to the feasibility of extending navigation up to Paterson, and Colonel Barlow presents a plan for improvement estimated to cost $1,133,563 and $5,000 annually for maintenance. The reports were transmitted to Congress and printed in House Doc. No. 401, Fifty-sixth Congress, first session. (See also Appendix H 23.)

5. *Preliminary examination and survey of Woodbridge Creek, New Jersey.*—Colonel Barlow submitted reports dated May 2 and December 18, 1899, respectively, with plan for improvement at an estimated cost of $35,000 and $3,000 annually for maintenance. In his opinion the important and increasing commerce of the locality will justify the

improvement proposed. The reports were transmitted to Congress and printed in House Doc. No. 282, Fifty-sixth Congress, first session. (See also Appendix H 24.)

IMPROVEMENT OF DELAWARE RIVER AND BAY AND OF CERTAIN WATERS TRIBUTARY THERETO, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, AND OF RIVERS AND HARBORS IN SOUTHERN NEW JERSEY.

This district was in the charge of Lieut. Col. C. W. Raymond, Corps of Engineers, to April 6, 1900, having under his immediate orders Lieut. Spencer Cosby, Corps of Engineers, to October 4, 1899, from November 2, 1899, to January 1, 1900, and from February 21 to April 6, 1900, in the temporary charge of Lieutenant Cosby from April 6 to May 31, 1900, and in the charge of Lieutenant-Colonel Raymond since May 31, 1900, with Lieutenant Cosby under his immediate orders since that date and Lieut. James B. Cavanaugh, Corps of Engineers, since June 11, 1900.

1. Delaware River, New Jersey and Pennsylvania.—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed, which carried from 3 to 6 feet at mean low water. At Kinkora Bar, about 9 miles below Trenton, there was a shoal carrying 7½ feet, and at Five-mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania channel, carrying only 3 to 4 feet at mean low water, there being, however, 13 feet of water past Five-mile Bar in the New Jersey channel passing south of Petty Island.

Below Philadelphia the river in its original condition presented obstructions at Mifflin Bar, which reduced the depth at mean low water to 17 feet; at Schooner Ledge and Cherry Island Flats, to 18 feet; at Bulkhead Shoal and Dan Baker Shoal, to about 20 feet, and at Duck Creek Flats, to about 20 feet. In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river and deepening the channel across Kinkora Bar.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay were confined to dredging, except at Schooner Ledge, where solid rock was removed under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship channel from a point opposite Philadelphia and about midway between the American Shipbuilding Company's yard and the Gas Trust wharf to deep water in Delaware Bay, having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel was to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary as an aid to such contracting and regulating works.

The estimated cost of obtaining a channel of the above dimensions was about $2,425,000, which covered the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. The annual cost of maintenance was estimated at 10 per cent of the original cost for dredging and 1 per cent of the original cost for dikes. This estimate of cost did not include the improvement of Philadelphia Harbor, which was a separate project.

The river and harbor act approved March 3, 1899, contained the following item:

> Improving Delaware River from Trenton to its mouth, Pennsylvania and New Jersey: Continuing improvement, three hundred thousand dollars, of which the Secretary of War may use so much as may, in his opinion, be required between Trenton and Christian street in Philadelphia, and the balance shall be available for obtaining a channel six hundred feet wide and thirty feet deep from said Christian street to deep water in Delaware Bay, in accordance with the report printed in House Document Numbered Two hundred and nineteen, Fifty-fifth Congress, second session, or such modified project as shall hereafter be recommended by a board of engineers and approved by the Secretary of War: *Provided,* That the total cost of the work shall not be increased thereby: *And provided further,* That the Secretary of War may enter into contract or contracts for such materials and work as may be required for prosecuting such improvement, not to exceed in the aggregate five hundred thousand dollars, to be paid for as appropriations may from time to time be made by law. The Secretary of War is hereby authorized to appoint a board of three engineers to make a further examination of the project and report such modification of the same as may be deemed desirable, with an estimate of the cost, the expense of such examination to be paid from the appropriation herein made.

The Board thus provided for was appointed, and met in Philadelphia in April, 1899, and September, 1899. After fully considering the subject of the improvement of the river, a report was submitted on September 8, 1899, and approved by the Secretary of War on September 20, 1899. It was submitted to Congress and printed in House Doc. No. 91, Fifty-sixth Congress, first session; it is also printed herewith as Appendix I 14. The report recommends a project for the formation of a channel 600 feet wide and 30 feet deep from Christian street in Philadelphia to deep water in Delaware Bay, at an estimated cost of $5,810,000.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1899, under appropriations for special localities and the general river was $2,954,725.17, of which $124,496.75 was expended on that part of the river between Trenton and Philadelphia. As the result of this expenditure there was at the latter date a channel of navigable width and 6 feet deep at mean low water through Perriwig Bar; a channel of navigable width and 7 feet deep in the eastern channel of the river at Bordentown; a channel through Kinkora Bar 8½ feet deep; a channel through Five-mile Bar over the whole width 26 feet deep; a channel 600 feet wide and 26 feet deep through the shoal areas at Port Richmond; a channel 600 feet wide and 26 feet deep at Otis Street Wharf; a channel through Mifflin Bar 600 feet wide and 26 feet deep (dredged by the city of Philadelphia); a channel through the rock area at Schooner Ledge 600 feet wide and 26 feet deep, and through the bar between Schooner Ledge and Marcushook 200 feet wide and 26 feet deep (improvement accomplished by the city of Philadelphia); channels through Holly Oak Reach, Cherry Island Flats, and the shoal below Christiana River (formerly included in Cherry Island Flats) 400 feet wide and 26 feet deep; a channel through Pennsville Shoals 26 feet deep; channels through the shoals between Pennsville and Bulkhead Bar 400 feet wide and 26 feet deep, at Bulkhead Bar 600 feet wide and 26 feet deep, and off Salem Cove 400 feet wide and 26 feet deep; a channel through Dan Baker Shoal 26 feet deep, except for a length of about 6,000 feet, where the channel had shoaled to its original depth of from 19 to 20 feet, and a channel through Duck Creek Flats 400 feet wide and 26 feet deep.

During the fiscal year ending June 30, 1899, the sum of $186,265.36 was expended in surveys and examinations, in dredging at Holly Oak Reach, Cherry Island Flats, shoal below Christiana River, shoal between Pennsville and Bulkhead Bar, and shoal between deep water above Dan Baker Shoal and deep water below Pea Patch Island (off Salem Cove), and in repair of Bulkhead Bar Dike.

During the past fiscal year the sum of $31,408.19 was expended in examinations, surveys, in the removal of rock opposite Petty Island, and in operations at Dan Baker Shoal for the formation of a 30-foot channel and the construction of a bulkhead for the reception of dredged material.

The changes during the past fiscal year are summarized as follows:

At rock opposite Petty Island the dredging of the blasted material has not yet resulted in the widening of the 26-foot channel on the Philadelphia side of the ledge.

At Dan Baker Shoal work has been confined to the construction of the bulkhead, and the operations of dredging have not yet been commenced. The channel dredged in 1897–98 has continued to shoal and now has a minimum depth of 16½ feet, while the length of the shoal area is about 12,000 feet. There is, however, a channel of navigable width and 22 feet deep at mean low water on the line of the proposed new channel to the westward of the existing range. The greatest draft of water that could be carried at mean low water on June 30, 1900, over the shoalest part of the river below Philadelphia was about 21.3 feet at Cherry Island Flats.

The benefits to navigation resulting from the improvement have been great. Previous to the improvement vessels of deep draft were compelled to utilize the high water of two tides in order to ascend the river to Philadelphia. They can now make the whole trip on a single tide.

For 1890 the total foreign freight movement of the Delaware River was estimated at 2,922,994 tons and the total domestic freight movement at 8,433,276 tons. For 1899 the total foreign freight movement was estimated at 4,340,010 tons and the total domestic freight movement at 17,570,222 tons. There has been an important increase in the foreign freight movement, most noticeable in the imports of iron ore and sugar and the exports of grain and oil, attributable in a great measure to the improvements of the river and harbor admitting deeper draft vessels. As the greater part of the domestic freight is carried in vessels of moderate draft, the increase in its movement can not be considered as due to the improvement of the river.

The foreign freight movement for 1899 was 371,908 tons in excess of the same movement for 1898, while the domestic freight movement for the same period was 3,017,176 tons in excess of that for 1898. The total value of the freight moved upon the river in 1899 is estimated at $1,312,079,652.

COMMERCIAL STATISTICS.

The following statement concerning the foreign commerce of the Delaware River for the years ending December 31, 1898 and 1899, is compiled from reports of the

Board of Trade, the Commercial Exchange, and the Maritime Exchange of the city of Philadelphia:

Articles.	1898.	1899.
IMPORTS.	*Tons.*	*Tons.*
Chalk	34,365	27,865
Drugs and chemicals	72,806	69,127
Hemp, jute, flax, and their fabrics	105,300	28,978
Iron ore	112,608	421,187
Sugar	364,931	422,828
Miscellaneous	259,587	300,455
Total	949,097	1,270,440
EXPORTS.		
Coal	492,403	485,604
Grain and flour	1,281,220	1,297,527
Petroleum and products	898,136	851,145
Miscellaneous	347,246	435,294
Total	3,019,005	3,069,570

The following statement concerning the domestic and coastwise commerce of the Delaware River for the years ending December 31, 1898 and 1899, has been compiled from returns made by shippers, consignees, and carriers:

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Chemicals	185,073	$3,017,085	155,603	$3,150,820
Coal	900,230	2,645,257	527,909	1,654,189
Lumber	857,619	4,725,928	502,549	9,901,674
Sand	1,083,933	681,716	787,018	512,947
Miscellaneous	2,672,691	330,073,878	4,118,300	636,073,098
Total	5,699,546	341,143,859	6,091,379	651,322,728
DEPARTING.				
Chemicals	93,263	2,316,005	81,792	2,085,405
Coal	5,133,750	15,281,522	7,322,026	25,453,530
Fertilizers	71,785	1,309,881	211,435	1,856,433
Iron, manufactured	144,231	3,798,512	128,681	5,438,186
Miscellaneous	3,410,471	297,141,829	3,734,909	510,638,104
Total	8,853,500	319,847,749	11,478,843	545,471,658

July 1, 1899, balance unexpended		$317,274.83
Amount appropriated by sundry civil act approved June 6, 1900		270,500.00
		587,774.83
June 30, 1900, amount expended during fiscal year		31,408.19
July 1, 1900, balance unexpended		556,366.64
July 1, 1900, outstanding liabilities	$150.00	
July 1, 1900, amount covered by uncompleted contracts	525,198.15	
		525,348.15
July 1, 1900, balance available		31,018.49
Amount (estimated) required for completion of existing project		5,371,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		[1] 761,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I 1.)

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[1] Of this amount $61,500 is required for the completion of the work provided for under the existing continuing contract authorized by the river and harbor act of March 3, 1899, and the remainder is to be applied to further work under the general project.

2. *Harbor between Philadelphia, Pa., and Camden, N. J.*—The final report of the local officer upon this improvement is printed in the Annual Report of the Chief of Engineers for 1899, page 1330.

On June 30, 1900, the maximum draft that could be carried at mean low water over the shoalest part of the improved channel was 26 feet. The amount expended under the project, including purchase of land, to June 30, 1899, was $3,934,912.30.

The reconstruction of the water fronts has progressed rapidly. Up to June 30, 1900, 33 piers had been completed to the new lines and 2 others were under construction. The city of Philadelphia has constructed a bulkhead on the new line from Vine to South street, which has permitted the widening of Delaware avenue at that locality to 150 feet.

The foreign freight movement of the port of Philadelphia for 1899, including all points on the Delaware River, is estimated at 4,340,010 tons, and the domestic freight movement at 17,570,222 tons. The improvement has greatly facilitated navigation and increased the amount of commerce.

The commercial statistics pertaining to this work are included in the statistics accompanying the report for the improvement of Delaware River.

July 1, 1899, balance unexpended	$87.70
June 30, 1900, amount expended during fiscal year	.46
July 1, 1900, balance unexpended	87.24

(See Appendix I 2.)

3. *Schuylkill River, Pennsylvania.*—When the improvement was commenced in 1870 there was a channel of entrance into the mouth of the river with a depth of only 10 feet at mean low water, so that the river was not navigable at high water for vessels of more than 15 or 16 feet draft.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide, with a depth of 20 feet from the mouth of the river to Gibson Point, about 4 miles, and a depth of 18 feet thence to Chestnut Street Bridge in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson Point, about 3 miles, to 250 feet wide and 20 feet deep. In 1892 the project was again modified so as to provide for the construction of dikes to maintain a navigable depth at the mouth. The estimated cost of the entire improvement was $529,959.

During the fiscal year ending June 30, 1897, 62,983 cubic yards of material, scow measurement, was dredged from the bar at the mouth of the river. The average depth of the channel across the bar along the line of deepest water was 27.5 feet at mean low water.

During the fiscal year ending June 30, 1898, the pile dike at the mouth of the river was raised and repaired by spiking on the face wall two courses of 12 by 12 inch pine timber, thus raising its height to about 9.5 feet above low water.

The earthen dike connecting with the pile dike was repaired and reconstructed for a distance of 410 feet.

During the fiscal year ending June 30, 1899, the filling of the pile dike was raised to the level of the face wall by the deposit of coarse gravel and bowlders.

The amount expended on this project to June 30, 1899, was $513,900. This expenditure has resulted in the formation of a channel about 125 feet wide and 24 feet deep at mean low water across the bar at the river's mouth; a channel about 250 feet wide and from 20 to 24 feet deep from inside the bar to Gibson Point, except at Yankee Point, where the width is 300 feet, and between Penrose Ferry Bridge and Yankee Point, where the 20-foot channel has narrowed to from 50 to 200 feet; thence to Walnut Street Bridge, a channel of navigable width and from 14 to 20 feet deep.

During the past five years the city of Philadelphia has been improving the channel under authorities granted by the Secretary of War under dates of September 3, 1895, and May 14, 1896. Dredging was commenced on November 13, 1895, and was finished on December 26, 1899, available funds having been exhausted. The total amount of material dredged and placed ashore is 615,377 cubic yards. This work has resulted in increasing the depths in the existing channel between Penrose Ferry Bridge and Fifty-eighth street, near Gibson Point, to 22 feet at mean low water and above Gibson Point to 20 feet, extending the existing channel to a point about 500 feet above Harrison's wharf, in all a distance of about 4.7 miles.

No expenditures have been made in connection with this work during the past fiscal year, and no improvement has been accomplished other than that effected by the city of Philadelphia in dredging a channel from 150 to 200 feet wide and 20 feet deep from a point in the vicinity of the Baltimore and Philadelphia Railroad Bridge to a point about 500 feet above Harrison's wharf.

On June 30, 1900, the maximum draft that could be carried at mean low water over the shoalest part of the improved channel was about 20 feet.

This improvement can be completed in accordance with the adopted project with funds now available. It is proposed to expend the available balance of $11,100 during the present season in redredging the bar at the mouth of the river. The survey of the river provided for in the river and harbor act of June 3, 1896, with a view to further improvement, was completed in December, 1897, and a project and report thereon, submitted March 10, 1898, was printed in House Doc. No. 346, Fifty-fifth Congress, second session; also in the Annual Report of the Chief of Engineers for 1898, page 1114.

The commercial interests of this river are of great and increasing value and importance. At Girard Point are located large grain elevators and wharves. At Gibson Point and Point Breeze, which are near each other and closely related as to commercial requirements, are the large storage tanks and wharves of the petroleum factories. The interests assembled at these three points cover mainly the commerce of the river, and both the grain and oil trade require deep-draft vessels for the convenient and economical transaction of their business. Channel depths are needed which will permit the passage of vessels drawing 24 feet at all stages of the tide. The total freight movement for the year 1899 is estimated at 3,483,822 tons (a decrease of 673,609 tons from the year 1898) and its value at $39,623,691 (a decrease of $7,264,953 from the year 1898).

COMMERCIAL STATISTICS.

The following statement of the foreign and domestic commerce of the Schuylkill River for the years ending December 31, 1898 and 1899, has been compiled from returns made by shippers, consignees, and carriers:

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Coal	396,073	$1,148,089	459,233	$1,599,677
Iron ore	80,957	890,483	127,300	1,018,400
Stone, building	24,341	209,894	17,864	111,914
Sand	306,362	173,088	564,088	298,070
Miscellaneous	184,851	4,418,082	221,649	3,677,508
Total	992,584	6,839,586	1,390,134	6,705,569
DEPARTING.				
Coal	159,736	394,447	122,485	384,355
Grain	665,700	11,000,000	578,500	8,500,000
Petroleum and products	2,244,053	23,617,047	1,136,616	17,109,652
Miscellaneous	95,356	5,037,565	256,087	6,924,115
Total	3,164,845	40,049,059	2,093,688	32,918,122

July 1, 1899, balance unexpended	$11,100.00
July 1, 1900, balance unexpended	11,100.00

(See Appendix I 3.)

4. *Ice harbor at Marcushook, Pa.*—This work in its present plan was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcushook extending from the shore line into the river. It is assumed that at some subsequent time these shore piers were turned over to the United States, since in 1829 an appropriation was made of $5,000 for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date a project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

In 1888 an increased depth was proposed for the areas protected by the detached piers outside of the natural shore line of the river.

The amount expended from 1866 to June 30, 1899, was $212,284.28, which was applied to the construction and repair of two landing piers, dredging the protected area to a depth of from 18 to 24 feet at mean low water, the placing and replacing of mooring piles, repairs to piers and mooring piles, and the necessary examinations.

During the past fiscal year no work was done and no expenditures were incurred.

On June 30, 1900, the areas protected by the detached piers had a mean low-water depth varying from 18 to 27 feet.

This harbor is of great value to vessels during the prevalence of ice in the river. The cost of its maintenance is trifling in comparison with the benefit derived from it.

It is proposed to hold the available balance of $1,715.72 for maintenance and repairs as needed.

July 1, 1899, balance unexpended	$1,715.72
July 1, 1900, balance unexpended	1,715.72

(See Appendix I 4.)

5. *Construction of iron pier in Delaware Bay near Lewes, Del.*—The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought-iron screw piles, surrounded with a timber superstructure. The work was commenced in 1871 and completed, except as to superstructure, in 1880.

The work done to June 30, 1890, resulted in the construction of 1,155 linear feet of pier 21 feet in width and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pierhead was about 21 feet at mean low water.

Since construction the pier has been repaired and cared for by the United States.

The total expenditures to June 30, 1899, were $385,322.39.

The right to use this pier for railway purposes, granted in the act of July 15, 1870, has never been exercised, and doubtless never will be, as the pier has not sufficient strength to support the weight of modern freight engines. It is therefore impossible to obtain any assistance from the railroad company in maintaining and repairing the structure.

The pier is of great use for the purposes of the Engineer, Light-House, and Quarantine services. It is of very great value to vessels frequenting the breakwater harbor in winter when the harbor is packed with floating ice, rendering the anchorage dangerous. At such times vessels eagerly seek its shelter and protection.

It is proposed to hold the available balance of $820.60 for maintenance and repairs as needed.

July 1, 1899, balance unexpended	$837.61
June 30, 1900, amount expended during fiscal year	17.01
July 1, 1900, balance unexpended	820.60

(See Appendix I 5.)

6. *Delaware Breakwater, Delaware.*—The final report of the local officer upon this work was submitted June 19, 1899, and is printed in the Annual Report of the Chief of Engineers for 1899, page 1346.

The depths in the protected anchorage vary from 12 to 18 feet at mean low water, and the harbor is available for vessels drawing up to about 16 feet.

The amount expended on this work up to June 30, 1899, was $2,807,283.96.

The Maritime Exchange of Philadelphia maintains a station on the breakwater, and through cables between the mainland and its station is in communication with the shipping of the harbor. Its reports state that during the year 1899 1,726 vessels, exclusive of tugs, fishing, and small coasting craft, anchored under the protection of the breakwater.

It is proposed to reserve the available balance of $1,056.02 for repairs to the breakwater and for surveys and examinations of the work.

July 1, 1899, balance unexpended	$1,069.74
June 30, 1900, amount expended during fiscal year	13.72
July 1, 1900, balance unexpended	1,056.02

(See Appendix I 6.)

7. *Harbor of refuge, Delaware Bay, Delaware.*—The project for the construction of this harbor, which was provided for on the continuous-contract system by the river and harbor act of June 3, 1896, includes the construction of a breakwater on the line of least depth along the eastern branch of the shoal known as the "Shears," and the construction of a row of ice piers across the upper end of the harbor to protect it from ice descending the bay, at a total cost not to exceed $4,665,000.

The act provides that in making the contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July 1, 1897, more than 25 per cent of the whole amount authorized to be expended.

No expenditures were made upon this improvement previous to June 30, 1896.

During the fiscal year ending June 30, 1899, $822,152.84 was expended and the construction of the breakwater continued by the deposit of about 450,460 tons of stone, making a total amount deposited to that date 749,204 tons.

During the past fiscal year about 345,895 tons of stone was deposited in the work. On June 30, 1900, the substructure had been brought to a width of 41 feet at mean low water for a distance of 8,000 feet, 1,790 feet of superstructure had been fully constructed to a height of 14 feet above mean low water, and 3,560 feet partially constructed.

A project for the construction of the ice piers was submitted on April 5, 1900, and approved April 23, 1900. It is proposed to enter into a contract during the coming fiscal year for the entire construction of these piers.

The sundry civil act approved June 6, 1900, contained an appropriation of $450,000 for continuing this improvement.

The price provided for in the existing contract justifies a reduction in the estimated cost of the work. It is now estimated that the total cost will not require further appropriation of more than $213,000, provided the annual appropriations are sufficient for rapid and economical progress. The additional appropriation is required mainly in connection with contract for ice piers to be made.

The great value of this harbor to commerce is due to its location. It is about equidistant from New York, Philadelphia, and the capes of Chesapeake Bay (the ocean entrance to the ports of Baltimore, Norfolk, and Newport News), and is therefore an especially convenient point of call for the entire commerce of the North Atlantic coast. It is now largely used by vessels awaiting orders to ports for discharge or loading, although the anchorage is exposed and dangerous, except for small vessels, which can find shelter in the old breakwater harbor. During the year ending December 31, 1899, 1,726 vessels (not including small craft) called at this locality.

By the construction of the breakwater the usefulness of this anchorage will be greatly increased, not only as a port of call, but also as a harbor of refuge. Vessels bound from northern to southern or from southern to northern ports will be able to go to sea in doubtful weather with the assurance of finding ample protection at the Delaware capes, if overtaken by storm.

July 1, 1899, balance unexpended		$754,181.16
Amount appropriated by sundry civil act approved June 6, 1900		450,000.00
		1,204,181.16
June 30, 1900, amount expended during fiscal year		482,136.69
July 1, 1900, balance unexpended		722,044.47
July 1, 1900, outstanding liabilities	$136,562.38	
July 1, 1900, amount covered by uncompleted contracts	580,592.09	
		717,154.47
July 1, 1900, balance available		4,890.00
Amount (estimated) required for completion of existing project		213,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		213,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix I 7.)

8. *Rancocas River, New Jersey.*—In its original condition Rancocas River carried a minimum low-water depth of 4½ feet between the mouth and Centerton, a distance of about 7½ miles, and from Centerton to Mount Holly, a distance of about 5½ miles, a ruling depth of about 2½ feet.

The original project of 1881 proposed the formation, by a dike at Coates Bar and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton, and thence to Mount Holly a channel 5 feet deep.

Operations under this project were carried on from 1881 to 1895. To the close of the fiscal year ending June 30, 1895, operations had been directed to the formation of a low-water channel 100 feet wide and 6 feet deep from the mouth to Centerton, and 50 feet wide and 5 feet deep for a distance of about 1¾ miles above Centerton.

During the fiscal year ending June 30, 1896, no work was done.

The appropriation of $2,000 for this river, made in the act of June 3, 1896, was required by the act to be expended in the improvement of the Lumberton Branch, and during the fiscal year ending June 30, 1897, the Lumberton Branch was surveyed, and a project for its improvement by dredging a channel through the shoals which obstruct navigation was submitted and approved.

During the fiscal year ending June 30, 1898, the project was completed by dredging through the shoals at Pattersons Landing, below Paxsons Landing, and partly through the shoal above Paxsons Landing, the channel having a width of 30 feet and a mean low-water depth of 6 feet.

Up to June 30, 1899, the total expenditures amounted to $39,520.54.

The river and harbor act of March 3, 1899, appropriated $2,000 for this river, to be expended in the Lumberton Branch. During the fiscal year ending June 30, 1899, a project for the expenditure of this appropriation was submitted and approved. The project provided for dredging through the shoals below Moores Landing and below Hainesport, as far as available funds would permit.

During the past fiscal year work under the project was in progress from July 18, 1899, to August 31, 1899, when it was completed. Five thousand eight hundred and seventy-nine cubic yards of material, place measurement, was removed from the shoal below Moores Landing, forming a channel 6 to 7 feet deep at mean low water and 30 feet wide entirely through the shoal.

The maximum draft of water that could be carried at mean low water on June 30, 1900, over the shoalest part of the locality under improvement was about 4½ feet.

The principal commercial interests are the manufacture of phosphorus and the transportation of sand and gravel.

The total value of the freight movement for 1899 was $1,785,503.

COMMERCIAL STATISTICS.

Arrivals and departures for the years ending December 31, 1898 and 1899.

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Coal	35,000	$125,000	38,000	$152,000
Iron, pig	4,100	53,300	5,000	100,000
Manure	78,000	97,000	63,000	94,500
Miscellaneous	22,780	345,600	25,200	370,350
Total	139,880	620,900	131,200	716,850
DEPARTING.				
Sand	150,300	150,000	246,742	211,158
Produce	5,620	595,000	3,120	420,000
Miscellaneous	5,980	298,500	6,210	437,500
Total	161,900	1,043,500	256,072	1,068,658

July 1, 1899, balance unexpended	[1] $2,379.37
June 30, 1900, amount expended during fiscal year	1,912.14
July 1, 1900, balance unexpended	[1] 467.23

(See Appendix I 8.)

9. *Cooper Creek, New Jersey.*—This creek enters the Delaware River in the city of Camden just above Cooper Point. It is navigable at mean high water for a distance of 9 miles from its mouth for vessels drawing 5 feet and for the first 5 miles for vessels of 11½-feet draft. The mean range of the tide at the mouth is about 6 feet. For a distance of 1½ miles from the mouth the width of the stream averages about 80 feet at low water and about 120 feet between the banks, and the channel in its original condition had a depth at mean high water of from 12 to 15 feet, except at one place, where the depth was 9½ feet.

The project for this improvement is printed in the Annual Report of the Chief of Engineers for 1895, page 1102. The project provides for the formation by dredging of a channel 70 feet wide at bottom and 18 feet deep at mean high water from the mouth of the creek to Browning's Chemical Works, and a channel of the same dimensions through the bar just outside the mouth, in all a distance of about 9,000 feet. The estimated cost, including contingencies, is $35,000.

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[1] Of this amount $399.70 is balance remaining from appropriation of August 18, 1894, not available for expenditure under the present project.

The river and harbor act of June 3, 1896, appropriated $37,000 for completing this improvement, of which $2,500, or so much thereof as might be necessary, was to be expended in rebuilding the dike on the Government reservation in the Delaware River at Woodbury Creek.

During the fiscal year ending June 30, 1897, the sum of $2,500 was expended in rebuilding the dike on the Government reservation at Woodbury Creek.

The amount expended on the project to June 30, 1899, including amount expended for rebuilding dike on Government reservation at Woodbury Creek, was $28,174.93.

The result of the dredging has been the formation of a channel extending from the mouth to the Camden Iron Works 7,500 feet long, 50 to 70 feet wide, except at the bridges, where the widths are 30 feet, and 18 feet deep at mean high water, except on the water pipe belonging to the city of Camden, where the the high-water depths are 14 to 15 feet.

During the past fiscal year no work has been in progress.

It is proposed to complete the improvement with funds now available as soon as the city of Camden removes or lowers the water pipe at State Street Bridge. The maximum draft of water that could be carried at mean low water on June 30, 1900, over the shoalest part of the locality under improvement was about 8 to 9 feet, which is the low-water depth on the pipe above mentioned. Elsewhere the low-water draft is from 10 to 12 feet.

There are 9 large manufacturing plants on this creek, consisting of 1 woolen mill, 1 nickel works, 4 chemical works, 1 glass works, and 2 iron works. It is claimed that with an improved channel the most economical way of receiving materials and shipping products will be by schooners instead of by rail, as at present.

The value of the total freight movement for 1891 was nearly $3,000,000, and for 1899, $2,642,155.

COMMERCIAL STATISTICS.

Arrivals and departures for the years ending December 31, 1898 and 1899.

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Chemicals	13,177	$193,100	10,251	$79,380
Coal	55,865	158,420	51,776	140,013
Fertilizer	6,174	80,300	6,790	88,330
Iron, pig	44,428	533,186	36,272	544,080
Miscellaneous	46,059	437,771	58,222	378,033
Total	165,703	1,402,727	163,311	1,229,836
DEPARTING.				
Iron, manufactured	19,585	390,700	13,357	333,925
Produce	85,000	650,000	37,500	720,600
Miscellaneous	10,377	801,290	11,615	357,794
Total	64,912	1,841,990	62,472	1,412,319

July 1, 1899, balance unexpended	$8,825.07
June 30, 1900, amount expended during fiscal year	.22
July 1, 1900, balance unexpended	8,824.85

(See Appendix I 9.)

10. Mantua Creek, New Jersey.—This creek empties into the Delaware River at a point 3 miles below League Island and opposite Mifflin Bar.

It is navigable at high water for a distance of one-half mile above its mouth to the phosphate works of the I. P. Thomas & Sons Company for vessels of 13 feet draft; thence 3¼ miles farther to Paulsboro for vessels drawing 9 feet; thence 3¼ miles to Parkers Landing for tugs and barges drawing 6 feet, this being the head of steam navigation; thence 4.1 miles to Mantua, 11¼ miles above the mouth, small boats and barges of 3 to 4 feet draft pass up on the tide. The navigable portion is generally bordered by low ground, protected from overflow by earthen banks. The general course of the stream is tortuous, and its navigation is much obstructed by bars, sharp bends, and in the upper portion by stumps and overhanging trees. The stream, on account of its flat watershed, is subject to only moderate freshets, which seldom exceed 2 to 3 feet above tide water. The range of tide is 6 feet at the mouth, 4.5 feet at Paulsboro, 3.4 feet at Berkley Bridge, and 2 feet at Mantua.

The low-water width near the mouth averages 160 feet, decreasing to about 100 feet at Paulsboro. Above Paulsboro the width decreases to 88 feet at Parkers Landing, and near Mantua to 50 feet.

The project for this improvement is contained in a report dated October 22, 1897, which is printed in the Annual Report of the Chief of Engineers for 1898, page 1122.

The improvement proposed is the formation, by dredging, of a channel 100 feet wide at the bottom and 12 feet deep from the 12-foot contour in Delaware River to the phosphate works; thence 80 feet wide at bottom and 8 feet deep to Paulsboro, and thence 60 feet wide at bottom and 7 feet deep to Parkers Landing; the construction (9,000 feet above Berkley) of a cut-off 350 feet long, 50 feet wide, and 3 feet deep; the removal of overhanging trees above Parkers Landing and the supplementing of the channel across the bar at the mouth by jetties on both sides, aggregating 1,350 feet in length, if found necessary for its maintenance.

Two plans for securing the channel are proposed. The first contemplates the formation of a dredged channel by making cut-offs, six in number, through the lowlands wherever practicable, avoiding shoals and sharp bends, subject to the condition that all right-of-way privileges can be secured and riparian rights quieted for a sum not exceeding $11,000. The second provides that in case the rights of way can not be secured and riparian rights quieted for the sum of $11,000, the route of the channel between the phosphate works and Parkers Landing is to follow the present course of the stream, widening at the bends.

The improvement by the first plan involves the removal of 411,500 cubic yards of material, place measurement, and its cost is estimated at $145,030; the second plan involves the removal of 405,500 cubic yards of material, and its cost is estimated at $141,400. The former plan is the one desired by the people of Paulsboro, as it shortens the distance between that place and the mouth of the creek nearly 2 miles.

It is proposed to cast the dredged material on the banks and behind the dikes, or otherwise dispose of it so that it shall not impair navigation.

This project was adopted by Congress in the river and harbor act of

March 3, 1899, which appropriated $25,000 for the improvement, subject to the following provision:

> *Provided*, That no part of any money appropriated for this project in excess of eight thousand dollars shall be expended for right-of-way privileges, easements, or other rights above the phosphate works and below Paulsboro, and no part thereof shall be expended for any such purpose unless all such rights are secured for an amount not in excess of said sum of eight thousand dollars.

During the fiscal year ending June 30, 1899, no expenditures were incurred for this improvement. An inquiry was in progress to ascertain whether all the right-of-way privileges, easements, and other rights above the phosphate works and below Paulsboro could be acquired for the sum of $8,000, as provided in the act of March 3, 1899.

During the past fiscal year, it having been found that the necessary rights of way could not be obtained for the sum of $8,000 through the excessive price demanded by one owner, it was recommended that proceedings be instituted for the acquirement of the necessary rights by condemnation. In the case of Mr. Howard W. Miller, one of the two owners through whose property one of the proposed cut-offs passes, condemnation proceedings were instituted by the Department of Justice in August, 1899, and an award of $4,642.35 made to Mr. Miller for his damage. Before proceedings were instituted in the case of Mr. Matthew Gill, the remaining property holder, the latter made a written offer to sell the necessary rights through his property for the sum of $3,357.65. This sum being considered reasonable for the rights taken, and the two amounts together not exceeding the limit of $8,000, as specified in the act, the offer was recommended for acceptance. This recommendation has not yet been approved.

The commerce of this creek consists of miscellaneous articles, such as coal, sand, lumber, merchandise, fertilizers, and produce, and is principally of interstate character. The phosphate works, located just above the mouth of the stream, import fertilizer material, potash, pyrites, nitrate of soda, and sulphuric acid, and export manufactured fertilizers.

The shipment of produce to Philadelphia, Chester, and Wilmington is a large industry.

The improvement will greatly benefit these industries and the local commerce.

The value of the total freight movement for 1899 was $2,538,850, an increase of $550,975 over that of 1894.

COMMERCIAL STATISTICS.

Arrivals and departures for the years ending December 31, 1898 and 1899.

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Chemicals	8,845	$142,880	7,505	$77,400
Fertilizer materials	13,964	350,000	19,500	253,000
Manure	33,000	66,000	33,000	66,000
Miscellaneous	25,725	668,250	26,135	45,400
Total	81,534	1,227,130	86,140	1,141,800
DEPARTING.				
Fertilizer, manufactured	16,300	326,000	24,350	390,750
Truck, produce, and grain	30,400	720,600	33,000	778,500
Miscellaneous	19,350	217,050	22,160	242,800
Total	66,050	1,263,650	79,510	1,412,050

It is proposed to apply the available balance of $25,000 as follows: $8,000 in the purchase of the right-of-way privileges, easements, and other rights above the phosphate works and below Paulsboro, N. J., as authorized by the river and harbor act of March 3, 1899, provided the offer of Mr. Matthew Gill, to sell the necessary rights of way through his property for the sum of $3,357.65, is accepted by the Secretary of War, and $17,000 in dredging under the project during the present season under a contract yet to be made.

It is proposed to apply the sum of $40,000, given as the amount that can be profitably expended in the fiscal year ending June 30, 1902, to the improvement of the channel between the Delaware River and Paulsboro, the amount of work to be done to depend on the prices obtained.

July 1, 1899, balance unexpended	$25,000.00
July 1, 1900, balance unexpended	25,000.00

Amount (estimated) required for completion of existing project	120,030.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 10.)

11. Alloway Creek, New Jersey.—In its original condition Alloway Creek was obstructed between its mouth and Quinton, a distance of about 10 miles, by shoal areas in the upper half of the stream, which reduced the low-water depths to from 1.3 to 4 feet.

The original project of 1889 proposed the formation by dredging of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock Bridge; thence a channel of the same depth and 75 feet wide to a locality known as the "Square," where the work is to be supplemented by a dike. At a locality known as the "Canal," in addition to a channel of the last-named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines. The project was modified on December 10, 1896, so as to provide for a dike formed by a single row of piles above the Upper Hancock Bridge. This modification does not increase the original estimated cost of the work, which was $25,000.

During the fiscal year ending June 30, 1897, 404 feet of dike was constructed above Upper Hancock Bridge.

During the fiscal year ending June 30, 1898, 4,269 cubic yards of material was dredged from the channel at Upper Hancock Bridge.

At the close of the fiscal year ending June 30, 1899, $14,978.11 had been expended in dredging at and near the Canal, the Square, and the Upper Hancock Bridge, and in dike construction at the Square and above Upper Hancock Bridge. Channels from 40 to 75 feet wide and 6 feet deep at mean low water were formed through the worst bars.

During the fiscal year ending June 30, 1899, a project for the expenditure of the appropriation of March 3, 1899 ($3,000), was submitted and approved.

The project provides for enlarging the channel by dredging at obstructing shoals below Upper Hancock Bridge, and above Upper Hancock Bridge for dredging through the shoals between the bridge and Quinton.

During the past fiscal year work under this project was in progress from July 20, 1899, to August 29, 1899, when operations were completed. Channels 6 feet deep at mean low water and 60 to 75 feet wide were dredged through the shoals at below the Square, Smith Reeves, Quinton, Upper Lamberts, Lower Lamberts, Upper and Lower Fowsers, and Upper and Lower Robinsons, 14,690 cubic yards of material, place measurement, being removed.

The maximum draft of water that could be carried at mean low water on June 30, 1900, over the shoalest part of the locality under improvement was about 5 feet.

The commerce of this creek consists of miscellaneous articles, such as coal, sand, lumber, and produce, and is principally of a local character. The value of the total freight movement for 1899 was $1,007,400. The improvement has been of much benefit to navigation at a comparatively small cost. About four-fifths of the projected work has been accomplished.

COMMERCIAL STATISTICS.

Arrivals and departures for the years ending December 31, 1898 and 1899.

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Coal	9,000	$20,000	9,500	$22,500
Lumber	2,500	30,000	3,000	35,000
Tin plate	1,500	100,000	1,800	110,000
Miscellaneous	20,950	61,000	26,600	230,700
Total	33,950	211,000	40,900	398,200
DEPARTING.				
Canned goods	8,000	375,000	9,000	400,000
Glass	2,000	125,000	2,300	150,000
Miscellaneous	5,125	55,500	5,825	59,200
Total	15,125	555,500	17,125	609,200

July 1, 1899, balance unexpended	$3,021.89
June 30, 1900, amount expended during fiscal year	3,021.89
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902	7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I 11.)

12. *Goshen Creek, New Jersey.*—In its original condition Goshen Creek carried a low-water depth of from 2 to 4 feet, with a least low-water width of 20 feet, and a high-water width of 36 feet from Goshen to a point about 4,000 feet below, and thence to the mouth, a distance of about 2,500 feet, a low-water depth of from 3 to 5 feet, with a least width of 30 feet.

The project for its improvement, adopted in 1891, proposed the deepening and widening by dredging of the 4,000 feet of the creek below Goshen Landing to a low-water depth of 3 feet and a width of 30 feet; the formation of a dredged channel 3 feet deep and about 50 feet wide through the bar at the mouth to the limit of the sand beyond the low-water line, and the protection of the channel by a sheet-pile jetty.

The improvement was commenced during the fiscal year ending June 30, 1893, and to the close of that year the sum of $2,770.16 was expended in widening and deepening the channel to the proposed dimensions over a distance of about 3,975 feet below Goshen Landing. By this work about one-fourth of the projected improvement had been completed and the navigable conditions had been proportionately improved.

During the fiscal year ending June 30, 1897, the pile dike was constructed to its projected length of 600 feet, and 8,002 cubic yards of material was removed from the channel in the vicinity of the dike.

The orginal cost of the project made in 1891 was estimated at $12,000, this estimate being based on a single appropriation of that amount by which the improvement could be made in a single season. On account of the small appropriations the execution of the work was carried through an interval of several years, and it was not executed with sufficient rapidity to prevent injurious changes, which considerably increased the cost of the improvement.

During the fiscal year ending June 30, 1898, an estimate for the completion of the project, based on a careful survey of existing conditions, was made. In order to maintain the dredged channel it was found necessary to extend the dike somewhat farther inshore and dredge through the bar at the mouth of the creek, which increased the cost of the project from $12,000, as originally estimated, to $17,000.

The total amount expended to the close of the fiscal year ending June 30, 1899, was $7,459.91.

The river and harbor act of March 3, 1899, appropriated $8,000 for the completion of this improvement. During the fiscal year ending June 30, 1899, a project for the expenditure of this sum and of a balance remaining from a previous appropriation was submitted and approved. The project provides for dredging a channel with a low-water depth of 3 feet entirely through the mouth of the creek and for repairing and extending the existing dike and constructing a short dike on the upper side of the mouth of the creek. Work under this project was commenced during the fiscal year ending June 30, 1899.

During the past fiscal year under this project the existing dike was repaired and strengthened with brush and stone, two parallel brush and stone dikes, on opposite sides of the-creek entrance, with a total length of 680 feet, were constructed, 10,436 cubic yards of material, dipper measurement, was removed from the bar at the mouth of the creek, and one of the brush and stone dikes repaired. By the work done the improvement is completed and no further appropriation is required. The maximum draft of water that could be carried at mean low water on June 30, 1900, over the shoalest part of the locality under improvement was about 2.5 feet.

The commerce of this creek consists of miscellaneous articles, such as sand, oysters, lime, côal, and lumber, and is principally of a local character. The value of the total freight movement for 1899 was $639,300. The improvement has been of much benefit at moderate cost.

COMMERCIAL STATISTICS.

Arrivals and departures for the years ending December 31, 1898 and 1899.

Articles.	1898.		1899.	
	Tons.	Value.	Tons.	Value.
ARRIVING.				
Brick	2,600	$17,800	2,000	$8,000
Fertilizers	1,600	42,000	1,200	15,200
Grain	5,400	75,600	5,500	115,500
Miscellaneous	7,000	240,400	7,200	294,400
Total	16,600	375,800	15,900	433,100
DEPARTING.				
Hay	3,500	21,000	3,500	24,500
Oysters and clams	2,500	98,000	2,500	100,000
Miscellaneous	10,000	69,000	8,600	81,700
Total	16,000	188,000	14,600	206,200

It is proposed to hold the available balance, $841.90, for repairs, maintenance, and other contingencies.

July 1, 1899, balance unexpended	$9,540.09
June 30, 1900, amount expended during fiscal year	8,698.19
July 1, 1900, balance unexpended	841.90

(See Appendix I 12.)

13. Removing sunken vessels or craft obstructing or endangering navigation.—During the past fiscal year the following wrecks were removed under the provisions of the river and harbor act of March 3, 1899: The sloop *John W. Elliott*, from the western edge of the eastern channel of Delaware River opposite the mouth of Alloway Creek, New Jersey, the work of removing which was commenced in the fiscal year ending June 30, 1899; the canal boat *William Cummings*, from the channel of Schuylkill River, Pennsylvania, near the Baltimore and Ohio Railroad Bridge, in the city of Philadelphia; the schooner *Addie Luddington*, from the main ship channel of Delaware Bay, about 1½ miles from Brandywine Shoal Light; the canal boat *James McNeal*, from the main ship channel of the Delaware River, off Snyder avenue, Philadelphia; the stern compartment of the canal boat *Victory*, from the channel of the Delaware River about one-third of a mile above Pennypack Creek, Pennsylvania; the schooner *Clara*, from the channel of Delaware River, about 2 miles below Billingsport, N. J.; the canal boat *May*, from the channel of Maurice River, New Jersey, and the canal boat *James Gillan*, from the channel of Schuylkill River, Pennsylvania, about one-quarter of a mile above Yankee Point.

Allotments were made for the removal of the wrecks of the following vessels: Canal boat *Frank Dodson*, from Chester Creek, Pennsylvania; proposals for the removal of the wreck will be opened July 2, 1900. Schooner *Druzilla B. Lee*, from Dennis Creek, New Jersey; contract for the removal of this wreck was entered into June 25, 1900, but the work of removal has not yet been completed.

The removal of the wreck of the schooner *Lottie K. Friend*, under contract dated February 18, 1897, with Thomas Poynter and Elijah D. Register, of Lewes, Del., in progress during the fiscal year ending June 30, 1897, was not completed, and the annulment of the contract was recommended June 16, 1898, and approved June 18, 1898. This wreck has not yet been removed.

The amount expended during the past fiscal year upon removal of wrecks is $2,905.53.

(See Appendix I 13.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Lieut. Col. C. W. Raymond, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination and survey of Raccoon Creek, New Jersey.—Lieutenant-Colonel Raymond submitted reports dated May 17, and December 11, 1899, respectively. He presents a plan for improvement estimated to cost $102,135. The reports were transmitted to Congress and printed in House Doc. No. 231, Fifty-sixth Congress, first session. (See also Appendix I 14.)

2. Preliminary examination and survey of Oldmans Creek, New Jersey.—Lieutenant-Colonel Raymond submitted reports dated April 18, 1899, and February 13, 1900, respectively. He considers the locality worthy of improvement by the General Government and presents a plan for improvement at an estimated cost of $60,000. The reports were transmitted to Congress and printed in House Doc. No. 464, Fifty-sixth Congress, first session. (See also Appendix I 15.)

3. Preliminary examination and survey of Maurice River, New Jersey.—Lieutenant-Colonel Raymond submitted reports dated June 8, 1899, and January 16, 1900, respectively. In his opinion the locality is worthy of improvement by the General Government and he presents a plan for improvement at an estimated cost of $98,000. The reports were transmitted to Congress and printed in House Doc. No. 344, Fifty-sixth Congress, first session. (See also Appendix I 16.)

4. Preliminary examination and survey of Tuckerton Creek, New Jersey.—Lieutenant-Colonel Raymond submitted reports dated April 18, 1899, and January 3, 1900, respectively. He considers the locality worthy of improvement by the General Government and presents a plan for improvement at an estimated cost of $61,380. The reports were transmitted to Congress and printed in House Doc. No. 274, Fifty-sixth Congress, first session. (See also Appendix I 17.)

REPORT OF BOARD OF ENGINEERS ON PROJECT FOR IMPROVEMENT OF DELAWARE RIVER FROM PHILADELPHIA, PA., TO DEEP WATER IN DELAWARE BAY, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

A Board of Engineers constituted in accordance with requirements of the river and harbor act of March 3, 1899, to consider and report upon the project for improvement of *Delaware River from Philadelphia to deep water in Delaware Bay*, submitted report dated September 8, 1899, with estimate of cost of securing a channel of the dimensions named in the act amounting to $5,810,000. The report was transmitted to Congress and printed in House Doc. No. 91, Fifty-sixth Congress, first session. (See also Appendix I 18.)

EXAMINATION OF BEACH THOROUGHFARE, NEW JERSEY, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Beach Thoroughfare, New Jersey*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE, IN MARYLAND EAST OF CHESAPEAKE BAY, AND OF INLAND WATERWAY FROM CHINCOTEAGUE BAY TO DELAWARE BAY, VIRGINIA, MARYLAND, AND DELAWARE.

This district was in the charge of William F. Smith, United States agent, major of engineers, United States Army, retired. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. Wilmington Harbor, Delaware.—The river and harbor act of June 3, 1896, authorized the making of contracts to complete the "modified project," which was understood to be the project for a 21-foot channel, at a cost not to exceed $225,846. Report upon this project will be found in the Annual Report of the Chief of Engineers for 1896, pages 973–994.

As it was doubtful whether the project could be carried out under the conditions of the law authorizing a contract, a Board of Engineer Officers was convened by the Chief of Engineers to consider and report upon the plan of improvement. The report of the Board is given in Appendix H 1 of the report for 1897, page 1255 et seq.

The Board expressed the opinion that the existing project could not be successfully carried out and recommended a modified project, including the construction of a jetty on the south side of the entrance to the river, the rectification of the channel of the Christiana River at the mouth of the Brandywine, and necessary dredging to give a channel of 21 feet at mean low water from the mouth to the upper line of the pulp works. The estimated cost was $377,542. It was stated that the proposed channel is of greater dimensions than the river can naturally maintain and that annual dredging will be necessary. The United States agent in local charge of this work estimated that certain rock work not included in above estimate would increase the cost of work $99,083, making the total estimate $476,625.

As this estimate exceeded the limiting cost in the authorization given in the act of June 3, 1896, no contract for work on the project could, under the law, be made. But the available funds, $15,000, were applied to dredging, in conformity with a recommendation of this Board.

The sundry civil act approved July 1, 1898, appropriated $205,846 for continuing the improvement, and for the expenditure of this amount contracts were made for dredging and for rock removal, both to a depth of 18 feet at mean low water, which depth was the extent to which the appropriation would go in the direction of an ultimate 21-foot depth.

The amount expended for the improvement of the Christiana River and Wilmington Harbor to June 30, 1899, was $453,552.62, of which $51,357.84 was expended on the present project.

The dredging in progress at the close of last fiscal year was continued under the contracts above mentioned with certain interruptions through the past year.

To the close of the fiscal year 1900 the channel had been dredged to a width, except at bridges, of 200 feet and a depth of 18 feet at mean low water from that depth in the Delaware River to the upper line of the pulp works, a distance of 21,298 feet, thence gradually diminishing to a depth of 10 feet at the Philadelphia, Wilmington and Baltimore Railroad Bridge No. 4, and thence for a distance of 11,300 feet to a width of 100 feet and a depth of 7 feet at mean low water.

A supplemental contract was made September 16, 1899, for removing rock from the ledges at the Third Street Bridge, at the price of the original contract, i. e., $7.13 per cubic yard in place, the depth to be made 21½ feet at mean low water. Under this contract and the others previously made 3,635 yards of rock, measured in place, were removed during the year.

The river and harbor act of March 3, 1899, appropriated $45,000 for continuing the improvement and authorized contracts to be made for completing it in accordance with the project submitted by the Board of Engineers in its report of October 3, 1896, including the removal of rock, as recommended in the Annual Report of the Chief of Engineers for 1897.

To carry out the provisions of this law plans were prepared for the work stated below, and after approval contracts were made, after due advertisement, and work done thereon, as follows:

Benjamin T. Collins, of Milford, Del., for the construction of a pile and stone jetty at the mouth of the Brandywine, 560 feet long, consisting of two wings, one extending from the shore of the Brandywine above the mouth, and the other from the Christiana River shore just above the point of junction with the Brandywine, the two following curved lines meeting in a common tangent. This was completed on April 30, 1900. The contract price was $7,310.80.

With Benjamin T. Collins, dated November 11, 1899, for construction of a pile and stone jetty 1,515 feet long on the south side of the mouth of the Christiana River, with a cross dike 1,170 feet long from the inner end of the jetty to the shore at high-water line. This work was begun on April 28, 1900, and is progressing favorably. The contract price is $33,512, and the work is to be completed in one hundred and eighty working days from January 8, 1900.

With Sanford & Brooks Company of Baltimore, Md., dated November 18, 1899, for the repair and extension of the jetty on the north side of the mouth of the river and the construction of a terminal crib. The plan of this extension carries the jetty to the 18-foot curve so as to make the currents of the Delaware and Christiana rivers parallel at their junction, the length being 313 feet. This work was begun April 23, 1900, and is progressing favorably. The price is $31,100, and the work is to be completed in two hundred working days from December 12, 1899.

For the dredging required to complete the project to a 21-foot depth contract was made with the Bowers Hydraulic Dredging Company, of Camden, N. J., at 10⅞ cents per cubic yard, place measurement. The contract provides for beginning the work on or before March 1, 1900, but the contractors did not begin until June 25, and the work done to the end of the month was only the dredging of a cut 50 feet wide and 1,100 feet long from the Philadelphia, Wilmington and Baltimore Railroad Cut-off Bridge No. 4, working downstream, in which section the depth increases from 10 feet at the upper end to 21 feet at the pulp works.

Soundings recently made show the condition of the channel as follows, the depth given being at mean low water:

At the outer end of the north jetty at the mouth of the Christiana River there was a depth of 14 feet for a width of about 150 feet; 1,130 feet up the river the depth was 18 feet for a width of 110 feet and 15 feet for a width of 150 feet; a half mile farther up the depth was 18 feet for a width of 110 feet and 15 feet for a width of 160 feet; 2,500 feet farther up (abreast of the Merchants Transportation Company's wharf) the depth was 12½ feet for a width of 150 feet and 15 feet for a width of 40 feet; through the draws of the Philadelphia, Wilmington and Baltimore Railroad Cut-off Bridge No. 3 the depth was 18 feet; at the mouth of the Brandywine the depth was 15 feet and over for a width of 90 feet; opposite the Atlantic Refining Company's property there was a depth of 18 feet and over for a width of 50 feet and 15 feet for a width of 110 feet; at the Jackson & Sharp Company's upper yard, a depth of 15 feet and over for a width of 130 feet; opposite the Pusey & Jones Company's railway, 14 feet for a width of 160 feet; through the south draw of Market Street Bridge for a width of 70 feet the depth was 15 feet and over, the maximum depth being 19 feet for a few feet in width in the center; at Harlan & Hollingsworth's dry dock there was a depth of 15½ feet for a width of 130 feet; at the old Walton & Whann Company's wharf the depth was 14½ feet for a width of 100 feet, and at the upper end of the pulp works the depth was 16 feet and over for a width of 120 feet.

These soundings are selected from the chart with the view of showing the general condition of the channel. Below the Philadelphia, Wilmington and Baltimore Railroad Cut-off Bridge No. 3 the channel was dredged to 18 feet deep at mean low water between December, 1898, and May, 1899; above that bridge to the Market Street Bridge, to 18 feet between May and September, 1899, except about 1,000 feet below the Third Street Bridge, abreast of Jackson & Sharp's, which was done in December, 1899, and above Market Street Bridge the 18-foot depth was made between September, 1899, and January, 1900.

This shows that the channel has narrowed and shoaled very much. The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the river was 14 feet for a width of 100 feet. The contract of the Bowers Hydraulic Dredging Company, now in operation, requires the dredging of this channel to a depth of 21 feet, and with the increased depth and cross section the rate of shoaling will be even greater, the extent of which can be determined only upon the completion of the work. No reliable estimate of the cost of maintaining the channel or suggestions regarding measures for its protection can be given at this time.

The tonnage and value of the leading articles shipped to and from the port of Wilmington in the year 1899, as reported by the board of trade, was 656,870 tons, valued at $27,228,390. The foreign commerce amounted to $4,864,907 additional. About $15,000,000 is invested in manufacturing and mercantile interests.

July 1, 1899, balance unexpended		$199,488.16
Amount appropriated by sundry civil act approved June 6, 1900		200,000.00
		399,488.16
June 30, 1900, amount expended during fiscal year		118,265.64
July 1, 1900, balance unexpended		281,222.52
July 1, 1900, outstanding liabilities	$3,000.00	
July 1, 1900, amount covered by uncompleted contracts	278,222.52	
		281,222.52

(See Appendix J 1.)

2. *Appoquinimink River, Delaware.*—At the time of the adoption of the present project there was a mean low-water depth of 2 feet at the entrance into Delaware Bay, and the shoalest depth inside the river was 4½ feet. The most serious obstructions to the navigation of the river were the many bends in the lower and middle sections.

The approved project is based upon a survey made in 1889, and is for a channel 8 feet deep at mean low water, having a width of 80 feet from the bridge at Odessa to near Townsend's wharf, a distance of 3½ miles, and a width of 100 feet from this wharf to the mouth of the river, a distance of 5 miles. The estimated cost of the improvement is $39,963.

In 1891 the channel was dredged to the full width of 80 feet and depth of 8 feet at mean low water for a distance of 1,975 feet in a down-river direction, beginning at the lower end of Watkins's wharf, at Odessa, and early in 1893 a farther distance of 4,487 feet was dredged. Of the latter, 595 feet was dredged to the approved width, but on account of the settlement and sliding in of the very soft marsh banks, upon which the excavated mud and sand were deposited, the full approved width of 80 feet could not be made along the remainder, 3,892 feet, and it was therefore made only 50 feet until the banks should become firmer. The entire length dredged was 6,462 feet, of which 2,570 feet is 80 feet wide and 3,892 feet is 50 feet wide. The channel was thereby materially improved as far as the work had progressed, giving great relief to the shipping, and the harbor room at Odessa increased.

During the years 1898–99 the channel was dredged and shoals removed to a width of 50 feet and a depth of 8 feet at mean low water as follows: At the upper point of and through Quarter Mile Reach; from just below Polk's wharf to above the lower corner of the steamboat wharf at Odessa; in Windmill Reach and Toms Bay Reach; below Windmill Reach and in the reach just above the one leading to New Bridge; the cut-off at No Man's Friend Reach was widened to from 60 to 70 feet through the straight portion of it, and still more at the ends, which were made fan shape; a cut-off 625 feet in length was made through the marsh at Thomas Landing, and another, 960 feet long, through the marsh just below. The aggregate length of dredging done in these operations was about 8,000 feet. At the mouth of the river a cut 30 feet wide and 5 feet deep at mean low water was made for a length of 1,100 feet through the marsh from the 5-foot depth inside the river to the 5-foot depth in the slough outside, through which deep water in the Delaware River is reached just below Blackbird Creek.

The amount expended on the improvement to the close of the fiscal year 1899 was $19,976.68.

For the expenditure of the $5,000 provided by the river and harbor act of March 3, 1899, contract was made, after due advertisement, for dredging at 12 cents per cubic yard, place measurement. Under this contract dredging was begun on April 19 and completed June 2, 1900. During this period the two cut-offs at Thomas Landing, the upper one about 650 feet long and the lower about 800 feet long, were dredged to a width and depth of not less than 80 feet and 8 feet at mean low water, respectively; at the mouth of the river the cut across the marsh was widened to 100 feet, the depth made being not less than 5 feet at mean low water; and at Toms Bay a cut 380 feet long was made through a sharp turn in the river, the width and depth made being not less than 35 feet and 6 feet at mean low water, respectively. The result of these operations is a good safe channel through the cut-offs and across the bar at the mouth.

The maximum draft that could be carried on June 30, 1900, at mean low water over the shoalest part of the river was 6 feet.

The commerce of the river for the year 1899 is reported to have been 23,200 tons, valued at $1,547,800. That reported in 1891, shortly after the improvement of the river was begun, was 19,132 tons, valued at $980,975.

July 1, 1899, balance unexpended	$5,023.32
June 30, 1900, amount expended during fiscal year	4,935.39
July 1, 1900, balance unexpended	87.93
Amount (estimated) required for completion of existing project	14,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix J 2.)

3. Smyrna River, Delaware.—This river, formerly called Duck Creek, had, before improvements were begun in 1879, a minimum depth of 2½ feet within the river and about 4 feet over the bar at the mouth. Navigation was possible only at high tide, and was carried on by one steamer and seven small schooners.

In 1878 a project was made for the improvement of the whole river, including a plan for deepening the channel across the bar at the mouth.

By direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating $10,000, were expended in dredging a channel across this obstruction 100 feet wide and 8 feet deep at mean low water. The dredged channel soon filled up again.

A new project was submitted in 1887 for a 7-foot low-water channel 60 feet wide inside the river and 100 feet at the bar, the channel at the latter point to be protected by a stone jetty. The estimated cost of this project is $91,698.40. The first appropriation under the project, that made in 1888, was for dredging, and the appropriations made since have provided for continuing the improvement and have likewise been applied solely to dredging. The estimated cost of the dredging was $37,365.20, and that for the jetty was $53,733.20.

In 1893 the channel was dredged to the approved dimensions for a length of 4,730 feet, in seven different localities between Smyrna Landing and Gravel Reach, about 5 miles below. Dredging had been done there previously, but not to the full dimensions. Also a cut 50 feet wide and 7 feet deep through a narrow bar about a half mile inside the mouth of the river. In 1896 the channel was dredged at various points between Smyrna Landing and Cave Landing Reach, a distance of 20,400 feet. The turning basin, as well as seven shoals below, was redredged to the project dimensions, and shoals at six other parts of this section were dredged to a depth of 7 feet at mean low water with widths varying between 40 and 60 feet. In 1897–98 the channel was dredged at various points between Cave Landing and Cherrytree Reach, resulting in a channel of the approved dimensions in that section, with the exception of about 300 feet just below Eagle Nest Landing, where the depth and width were at some places slightly less. In the section above Cave Landing six shoals, to and including a part of Walraven Reach, were dredged to the approved dimensions, except one at Deep Hole, where the width made was only 50 feet. The amount expended on this improvement to June 30, 1899, was $37,995.49, of which amount $27,995.49 is on the present project.

For the expenditure of the appropriation made by the river and harbor act of March 3, 1899, contract was made, after due advertisement, for dredging at the price of 12 cents per cubic yard, place measurement; and under this contract the channel was dredged between December 29, 1899, and February 14, 1900, to a width of 60 feet and a depth of 7 feet at mean low water through shoals at Walravens, Beaver House Reach, Rothwells Landing, and Deep Hole Reach, an aggregate length of 2,565 feet, and a continuous stretch of 5,210 feet from Walravens Point upstream, resulting in a channel of the project dimensions from the upper terminus to the bar at the mouth, with a turning basin at Smyrna Landing. This leaves the shoal at the bar at the mouth to be removed to complete the dredging.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the river to the bar at the mouth was 7 feet, and 2 feet across the bar.

The commerce on the river for the past year is reported to have been 339,791 tons, valued at $3,769,275. Before the improvements were begun the tonnage and valuation were reported to be 204,706 tons, and $1,944,000 valuation.

July 1, 1899, balance unexpended	$5,004.51
June 30, 1900, amount expended during fiscal year	4,544.51
July 1, 1900, balance unexpended	460.00
Amount (estimated) required for completion of existing project	4,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	5,300.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix J 3.)

4. *Murderkill River, Delaware.*—This river is a tidal stream and a tributary of Delaware Bay, and flows through Kent County, Del. Its navigable portion is about 9 miles long. The condition of the river was fair for the greater part of its length, the average width and depth being 90 and 6 feet, respectively. Outside the junction with Delaware

Bay, however, there is a serious obstruction—the flats—which are nearly bare at low tide and extend for nearly a mile from the shore. The average rise and fall of the tide at the mouth is 4.6 feet.

In 1881 an examination of this river was made and a project submitted for its improvement. No appropriation was made by Congress, however, as the river was at that time in the hands of an improvement and navigation company chartered by the State. This company had expended about $10,000 in rectifying the many bends of the river by cutting straight canals and in dredging a narrow cut across the flats at the mouth. The latter slowly filled up again.

The project for improvement adopted in 1892 is for a 7-foot low-water channel 80 feet wide from the town of Frederica, at the head of navigation, to the mouth of the river, and 150 feet wide from the mouth across the flats outside to the 7-foot depth in Delaware Bay, the cut at the mouth to be protected by forming an embankment of the dredged material on each side, the estimated cost being $47,550.

In 1893 a channel was dug to a depth of 5 feet below mean low water across the flats from a short distance inside the river to the 5-foot depth in Delaware Bay, and in 1895 a cut-off 975 feet long was made at Lower Landing, about 4 miles from the mouth, and shoals were dredged at a sharp turn in the river below Frederica, at the head of Long Canal, at Coles Shoal, and just inside the mouth of the river. The width of the cut in every case was 40 feet and the depth 7 feet at mean low water. In the winter of 1896–97 a channel was dredged 60 feet wide and 6 feet deep at mean low water from the 6-foot curve in Delaware Bay to the steamboat wharf inside the river, a distance of 4,700 feet, and shoals just above the steamboat wharf, at Broad Reach and at Webbs Landing, aggregating 2,482 feet in length, were dredged to a width of 40 feet and a depth of 6 feet, resulting in an unobstructed low-water navigation of 6 feet from that depth in Delaware Bay to Lindells Shoal, a distance of 16,000 feet.

The amount expended on the project to the end of the fiscal year 1899 was $18,495.90. In addition to this, $1,500 was expended in removing a shoal at the mouth of the St. Jones River, as required by river and harbor act of August 18, 1894.

For the expenditure of the $5,000 provided by the river and harbor act of March 3, 1899, contract was made, after due advertisement, for dredging at 12 cents per cubic yard, place measurement. Under this contract dredging was begun August 17 and completed December 14, 1899, and during this period shoals at the steamboat wharf at Frederica and 500 feet below, at Long Reach, Bradleys Canal, Goodwins and Lower Landing, aggregating about 4,000 feet in length, were dredged to a width of 40 feet and a depth of 6 feet at mean low water, and at the mouth the channel was dredged to a width of 60 feet and a depth of 6 feet at mean low water to that depth in Delaware Bay, resulting in a channel 6 feet deep at mean low water from the head of navigation at Frederica to Delaware Bay. An allotment of $3,500, from appropriation by emergency river and harbor act of June 6, 1900, for restoring channel in St. Jones River, was made June 30, 1900.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the river was 6 feet to the mouth and 5 feet across the flats at the entrance.

The commerce of the river, which is quite varied, is reported for the past year as 45,954 tons, valued at $1,756,015. There appears to have been quite an increase since the improvements were begun, and a steamboat line has in consequence been established between Frederica and Philadelphia.

July 1, 1899, balance unexpended		$5,004.10
June 30, 1900, amount expended during fiscal year		4,864.88
July 1, 1900, balance unexpended		139.22
Amount (estimated) required for completion of existing project		27,764.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$7,000.00	
For maintenance of improvement	1,000.00	
		8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix J 4.)

5. *Mispillion River, Delaware.*—This river is a tidal stream, and enters Delaware Bay about 17 miles northwest of Cape Henlopen. It is navigable for about 12 miles. The mouth of the river is greatly obstructed by a flat foreshore without a channel. Vessels can enter and depart only at high water, which rises, on an average, 4 feet.

The river from Milford to the mouth was improved by the General Government between the years 1879 and 1889, and $17,000 was expended in making a channel 40 feet wide and 6 feet deep at mean low water.

The project for the improvement at the mouth of the river, proposed in a report on a survey made in 1891, provides for a cut across the flats in a southeasterly direction, having a width of 150 feet and a depth of 6 feet at mean low water, beginning opposite the light-house and ending in deep water in the bay, the cut to be protected on the upper or north side by a bank made of the excavated material. The estimated cost is $24,000.

In 1893 operations were begun under the project, and at the close of work in that season a pile dike 500 feet long had been built on the north side of the mouth, along the line of the channel, and a channel had been dredged for a length of 570 feet, 80 feet wide and 5 feet deep at mean low water, extending from the 5-foot depth in the Mispillion River to a point opposite and 50 feet west from the outer end of the dike, and in 1895 and 1896 a channel was dredged 75 feet wide and 6 feet deep at mean low water from inside the river just above Sandy Point to opposite the mouth of Cedar Creek, and a crib dike 350 feet in length, flanking the new channel on the west side, was built. The dikes were found necessary during the progress of the dredging, owing to the character of the material dredged, which was mainly treacherous sand.

In 1897 a brush and stone extension to the pile dike was built for a length of 200 feet, and a cut 50 feet wide and 6 feet deep at mean low water was dredged a length of 450 feet near the end of the crib dike, but was soon obliterated during severe storms. A channel 4 feet deep at mean low water and 40 feet wide was then dredged across the Bulkhead Shoal, about 400 feet beyond the mouth, resulting in a continuous channel 4 feet deep from inside the river across the Bulkhead Shoal. The amount expended to June 30, 1899, was $38,999.48, of which $21,999.48 is on the present project.

The river and harbor act of March 3, 1899, appropriated $2,500 for the improvement, and for the expenditure of this a contract was made with Benjamin T. Collins, dated July 25, 1899. Under this contract a single pile jetty was built for a length of 141 feet, extending from the inner end of the old pile and brush jetty northward to the high-water line of the Mispillion River, and a similar jetty from Green Point, due east, for a length of 206 feet. The latter, which is designed to direct the waters of Cedar Creek into the Mispillion currents, was to extend much farther out, but it was found necessary to reduce its proposed length by about one half, thus permitting the use of the old channel down the bay shore, as a break through a cut made at the mouth by private parties in 1898 under authority of the War Department had damaged the channel in the route of the original project to deep water in Delaware Bay.

The maximum draft that could be carried, June 30, 1900, at mean low water, over the shoalest part across the mouth of the river was 2 feet.

The commerce of the river consists principally of lumber, railroad ties, grain, canned goods, lime, and fertilizers, and is reported to have been 103,432 tons, valued at $1,902,840, in 1899. In 1892 the commerce reported was 67,396 tons, valued at $1,651,405.

July 1, 1899, balance unexpended	$2,500.52
June 30, 1900, amount expended during fiscal year	1,537.83
July 1, 1900, balance unexpended	962.69
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix J 5.)

6. *Broadkill Creek, Delaware.*—In its original condition the depth of water in the creek was from 3 to 4 feet at the numerous shoals which impeded navigation. The depth at the entrance was and still is from 1½ to 2 feet at low water.

The original project for improvement, made in 1871, is for a 6-foot low-water navigation, with a minimum width of 40 feet from the mouth of the creek to Milton, the head of navigation, and for a new entrance, protected by a jetty, at an estimated cost of $80,447. This project was modified in 1881 relative to the entrance, and the estimate reduced to $51,450. The channel within the creek has been completed in accordance with the project, at an expense of $35,000, which was the total amount expended at the close of the fiscal year ending June 30, 1899.

After entering, vessels were no longer detained by the shoals at low tide and could proceed directly to their destination.

The amount estimated for the completion of the project is for the improvement at the mouth of the creek, as designed in 1871 and modified in 1881. No work has been done on it since 1890, and no funds have been available for the purpose.

Amount (estimated) required for completion of existing project	$21,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 6.)

7. *Inland waterway from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Del.*—The original project, based on a survey made in 1884, provided for a channel 70 feet wide at the bottom and 6 feet deep below mean low water in the Delaware Breakwater Harbor connecting the inland bays between Chincoteague Bay and Delaware Bay, the northern outlet to be at or near Lewes, Del. The length of the proposed waterway is about 75 miles, and the cost was estimated at $350,000. This project was modified in 1892, the width of the proposed channel having been reduced to 20 feet at the bottom.

A cut has been made 4 miles long, 20 feet wide at bottom, and 4 feet deep below the mean level of Assawaman Bay across the neck of land lying between little Assawaman Bay and Whites Creek, a tributary of Indian River Bay, and three temporary wooden bridges built over it; a cut 20 feet wide and 6 feet deep below datum (mean low water at Delaware Breakwater) has been made from that depth in Rehoboth Bay to a point 1,250 feet south of the Delaware, Maryland and Virginia Railroad crossing at Rehoboth, a distance of 9,000 feet, and another cut, in continuation of this, extending to the railroad reservation, a distance of 1,125 feet, has been made to a depth of 2 feet below mean low-water level; and north of the railroad crossing a cut was made to a point 1,000 feet north of the boundary of the railroad track. Of this latter distance the lower 800 feet was excavated to a depth of 9½ feet and the remaining 200 feet to an average depth of 15 feet above datum, the depth of cutting in the first averaging approximately 17½ feet and in the latter about 8 feet. All slopes of excavations were made 2 to 1 along the lines determined by the final width at the base of the proposed cut and the configuration of the ground. The cut between Assawaman Bay and Whites Creek was made and the three bridges built in 1891. The remainder of the work described was done between 1893 and February, 1896.

The amount expended on the project to June 30, 1899, was $167,255.28, and the condition of the work when last examined, in 1896, was as follows: The cut made between Whites Creek and the head of Little Assawaman Bay to a depth of 4 feet had shoaled considerably, at the northern end to eight-tenths of a foot and in the middle portion to 2 feet. The first-named shoal is in the deepest portion of the cut, where the sandy side slopes, bare of all vegetation, fall in considerably during heavy rains. The depths in the cut through low or marshy ground had maintained themselves very well. The cut made to a depth of 6 feet from Rehoboth Bay along Millers Creek toward the high ground back of Rehoboth, during the working season of 1894, was in fair condition except the formation of a slight shoal in line with the bay shore, which was evidently caused by wave action.

The river and harbor act of June 3, 1896, appropriated $25,000 for continuing this improvement, to be used from Delaware Bay to Indian River, but it was not deemed advisable to do any work on this section until certain questions respecting the right of way could be adjusted. That act also provided for securing the right of way over any railroad or through any railroad or county bridge by condemnation proceedings. Such proceedings were instituted under authority of the Secretary of War by the United States attorney for the district of Delaware for the right of way through the crossing of the Delaware, Maryland and Virginia Railroad Company at Rehoboth, Del., resulting in a voluntary deed dated January 13, 1899, from the commissioners of Rehoboth to the United States, conveying whatever interest that corporation had in the land at the place named, and in an award, made by certain commissioners appointed under and by virtue of an act of the general assembly of the State of Delaware, entitled "An act in relation to the proposed canal intended as a free inland waterway connecting Assawaman Bay with Delaware Bay," passed at Dover, April 4, 1884, and the supplements thereto, as stated more fully in the Annual Report of the Chief of Engineers for 1899, page 191. The amount of the award is $37,343.58.

July 1, 1899, balance unexpended	$26,494.72
July 1, 1900, balance unexpended	26,494.72

Amount (estimated) required for completion of existing project	156,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 7.)

8. *Susquehanna River above and below Havre de Grace, Md.*—Before improvements were begun in this section of the river the least depth of water over the shoals between Havre de Grace and Spesutia Island was 5 feet at low water. The channel above Havre de Grace between Watson Island and the shoal running out from the west shore was narrow, and believed to be one of the causes of ice gorges at and near Port Deposit.

Improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and for the removal of the shoal opposite Watson Island to a depth of 8 feet below mean low water. Estimated cost, $168,000.

The channel below Havre de Grace was dredged the last time in 1885. It has shoaled again. The channel at Watson Island has been widened about 400 feet, but the shoal which was removed has nearly entirely re-formed since the discontinuance of work in 1889.

Up to the close of the fiscal year ending June 30, 1899, $161,155.95 had been expended on this section of the river, including $49,729.15 for work for the Fish Commission.

There were no operations on the project during the past fiscal year. The small amount available is limited to expenditure above the Philadelphia, Wilmington and Baltimore Railroad Bridge.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the channel from the Chesapeake Bay to Port Deposit, was 10 feet.

It was impracticable to obtain complete commercial statistics.

July 1, 1899, balance unexpended	$9,734.05
July 1, 1900, balance unexpended	9,734.05

(See Appendix J 8.)

9. *Rockhall Harbor and inner harbor at Rockhall, Md.*—The river and harbor act of June 3, 1896, appropriated $9,600 for Rockhall Harbor for completing improvement in accordance with report submitted by Gen. Wm. P. Craighill, Corps of Engineers, January 7, 1895; also $7,000 for improving inner harbor at Rockhall, in accordance with report submitted by the Chief of Engineers in House Ex. Doc. No. 200, Fifty-third Congress, third session.

A project for the expenditure of the appropriation made for this work was carried out in 1897–98, by making a cut 80 feet wide and 10 feet deep at mean low water from the 10-foot curve in Swan Creek Inlet to the 10-foot depth in Chesapeake Bay, a distance of about 4,600 feet, and a channel 100 feet wide and 10 feet deep at mean low water from that depth in Swan Creek Inlet to the old pier at Rockhall. The operations resulted in a continuous 10-foot mean low-water channel from Rockhall to Chesapeake Bay, shortening the distance to Baltimore considerably. A turning basin embracing both the old and new piers at Rockhall was also made.

The amount expended on this improvement to June 30, 1899, was $15,501.38. The expenditures during the past year were outstanding liabilities.

No examination has recently been made at Rock Hall, but over the shoalest part of the channel at Swan Point Bar there was probably on June 30, 1900, a depth of 8 feet for a width of not over 25 feet, and in the inner harbor 10 feet.

No complete commercial statistics have been obtained.

July 1, 1899, balance unexpended		$1,098.62
June 30, 1900, amount expended during fiscal year	$1,095.74	
Returned to Treasury—unexpended balance	2.88	
		1,098.62

(See Appendix J 9.)

10. Queenstown Harbor, Maryland.—This harbor was improved by the General Government between the years 1871 and 1880. In the latter year a project for making a channel 100 feet wide and 8 feet deep at mean low water from the Chester River to the inner harbor was completed.

In 1896 Congress appropriated $5,000 for continuing the improvement; and with this appropriation the channel was dredged to a depth of 8½ feet at mean low water, the work being completed in June, 1897. The amount expended to June 30, 1899, was $17,762.48, of which $14,000 was on previous projects.

The work done during the past fiscal year was confined to the removal of a shoal which had formed near the outer light. This shoal extended from a point 138 feet above the lower light down for a distance of 950 feet, and had advanced in some places almost across the channel. Two cuts were dredged, 40 feet wide each, one for a length of 800 feet and the other 950 feet. The depth made was 8 feet at mean low water.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the channel was 8 feet.

It was impracticable to obtain complete commercial statistics. The tonnage reported in 1898 was 25,845 tons.

July 1, 1899, balance unexpended	$1,237.52
June 30, 1900, amount expended during fiscal year	848.09
July 1, 1900, balance unexpended	389.43

(See Appendix J 10.)

11. Chester River, Maryland, from Crumpton to Jones Landing.—This river is a tidal stream 40 miles long, forming the boundary line between Kent and Queen Anne counties, eastern shore of Maryland, and flows into Chesapeake Bay. It is navigable for vessels drawing 6 feet of water at low tide as far as Crumpton, about 33 miles above the mouth. The least depth of water within the last 7 miles of the river is 3 feet. At Crumpton the average rise of the tide is 2.1 feet. A short distance from this town several shoals have previously been improved by the United States.

The project for improvement is for a 6-foot low-water channel from Crumpton to Jones Landing, a distance of 6¼ miles, at an estimated cost of $12,750, which was later, in 1896, increased to $14,250.

In 1893 the channel was dredged in accordance with the project at various points between Crumpton and Kirbys Landing, a distance of about 4 miles. In 1894 the channel was dredged a length of 850 feet, and in 1898 a distance of 1,700 feet, including a length of 300 feet previously dredged and which had shoaled considerably. This left a stretch of about 1 mile to be dredged to complete the project.

Up to the close of the fiscal year ending June 30, 1899, $10,879.74 had been expended on the improvement.

Under contract made September 25 and approved October 18, 1899, the channel was dredged during the months of October and November, 1899, to the project width and depth from the point where operations were suspended in 1898 for a distance of 2,925 feet, or to about 2,900 feet below Jones Landing, the upper terminus under the project. To dredge this remaining distance to Jones Landing and to redredge the channel where it has shoaled will, it is estimated, require the removal of 32,500 cubic yards of material, at a cost of $5,350. This amount is included in the estimate given below. No provision was made for maintenance in the original estimate, and the work has extended over a period of nine years, during which time the channel has been redredged from time to time where needed as far as the money appropriated would permit.

The object of the improvement is to extend navigation farther up the river, and the nearest point above for a landing is at Jones Landing, which is near the county road. The maximum draft that could be carried June 30, 1900, over the shoalest part of the improved portion of the river, or to within 2,900 feet of Jones Landing, was 4 feet, and above it was 2 feet, at mean low water.

The commerce of the river consists mainly of agricultural products. No complete statistics have been obtained, but the Chester River Steamboat Line reported its business for 1898 as 79,201 tons, valued at $3,063,985. There is no marked improvement in the commerce of the river, and none to be looked for until the completion of the project. The improvements made thus far have facilitated navigation.

July 1, 1899, balance unexpended	$3,320.26
June 30, 1900, amount expended during fiscal year	2,804.35
July 1, 1900, balance unexpended	515.91
July 1, 1900, outstanding liabilities	249.12
July 1, 1900, balance available	266.79
Amount (estimated) required for completion of existing project	5,350.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	5,300.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 11.)

12. *Choptank River, Maryland.*—Before improvements were begun, in 1879, the depth of water in the channel between Denton and Greensboro varied from 2 to 8 feet at low water. Navigation, carried on by

small sailing vessels, extended only to 3 miles above Denton. Upon the remaining 5 miles to Greensboro all freight had to be transported upon scows.

A project for improvement was made in 1880 for an 8-foot low-water channel 75 feet wide, at an estimated cost of $79,000, and up to the year 1897 a channel had been made not less than 75 feet wide and 7½ feet deep between Greensboro and Brick Mills, a distance of about 4 miles, and to a width of 75 feet and a depth of 8 feet for a farther distance of 1,800 feet below the Brick Mills. The remaining distance to Denton has been partly improved by dredging the channel where needed to depths of 5 and 6 feet and by widening it to about 40 feet. Shortly after the main obstructions had been removed in 1887 steamboat communication with Baltimore was established, and since that time commerce has steadily increased.

In 1898–99 a cut 40 feet wide was dredged between the bridge at Greensboro and a point 1,130 feet below, at which point dredging in an upriver direction had stopped in previous operations, and several shoals from 10 to 30 feet wide and aggregating 830 feet in length were dredged to the approved depth; and at Brick Mills the channel was dredged for a length of 1,000 feet to a width of 65 feet. The depth made in these operations was 8 feet at mean low water.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1899, was $51,847.83.

For the expenditure of the $8,000 appropriated by the river and harbor act of March 3, 1899, contract was made, after due advertisement, for dredging, at 12.4 cents per cubic yard, place measurement, and under this contract the channel was dredged between November, 1899, and April, 1900, to the approved dimensions, 75 feet wide and 8 feet deep at mean low water, from the railroad bridge above Denton to the Brick Mills, and from Greensboro, in a down-river direction, a distance of 4,760 feet, and a turning basin was dredged at Greensboro. This leaves a stretch of about 1,600 feet, previously dredged to 7 feet, to be dredged to an 8-foot depth, and for restoration of the channel where it has shoaled to complete the project.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the river under improvement was 6.5 feet.

The commerce consists largely of agricultural products and canned goods. The tonnage reported for 1899 is 21,399 tons, valued at $1,040,957. In 1890 the commerce reported was 6,904 tons, valued at $164,192.

July 1, 1899, balance unexpended		$8,152.17
June 30, 1900, amount expended during fiscal year		7,357.45
July 1, 1900, balance unexpended		794.72
July 1, 1900, outstanding liabilities		682.04
July 1, 1900, balance available		112.68
Amount (estimated) required for completion of existing project		8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$4,000.00	
For maintenance of improvement	2,000.00	
		6,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix J 12.)

13. La Trappe River, Maryland.—This river, formerly called Dividing Creek, is in Talbot County, eastern shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is about 3 miles long, has no fresh-water inflow at the head, and was originally only 4 feet deep. The entrance to the river was seriously obstructed by several shoal bars, with a least depth of 9 feet in the narrow channel, which was very tortuous and about one-half of a mile long. The average rise of tide is 1.55 feet.

Previous to the adoption of the present project the sum of $5,333.50, raised by private subscription, had been expended in dredging at the head of the river and at the bar at the mouth. The average depth in the river was thereby increased to 8 feet and the channel at the mouth was somewhat widened.

The present project for improvement provides for a channel 150 feet wide and 11 feet deep across the bar at the mouth and for a channel 75 feet wide and 8 feet deep at mean low water inside the river as far as Trappe Landing, situated at the head of navigation, and a turning basin at the latter point. The estimated cost was $7,250.

Up to the close of the fiscal year ending June 30, 1899, $7,213.87 had been expended and the proposed channel within the river had been completed. The proposed channel at the mouth, about 1,600 feet long, had been dredged to the approved width of 150 feet for a distance of 400 feet and to a width of 100 feet only for the remaining 1,200 feet. No work has been done during the past fiscal year. The channel in this 1,200 feet, therefore, remains to be widened 50 feet in order to conform to the approved project, and it is estimated that to complete it $2,500 will be required in addition to the amount already expended and originally estimated as the cost of the whole improvement.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part at the bar was probably 9 feet and in the upper river 7½ feet.

In 1893, when the improvement of the river began, the tonnage reported was 29,094 tons, valued at $897,450. In 1899 the commerce reported was 12,593 tons, valued at $226,950. The improvements thus far have facilitated commerce, but have not increased it.

July 1, 1899, balance unexpended	$36.13
July 1, 1900, balance unexpended	36.13
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 13.)

14. Warwick River, Maryland.—This river, formerly named Secretary Creek, is in Dorchester County, eastern shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is a small tidal basin 2 miles long, with no fresh-water influx at the head, and was originally only 4 feet deep. The average rise of the tide is 1.7 feet.

Before the adoption of the present project about $12,000 had been expended in the improvement of this river, $6,000 by the General Government, and the remaining amount by private parties. The present project for improvement, which was proposed in a report on a survey in 1891, provides for a channel 100 feet wide and 10 feet deep at mean low water from the 10-foot depth in Choptank River to Secretary Landing, at the head of the river, including a turning basin at the latter point, at an estimated cost of $18,600.

In 1892–93, beginning in the Choptank River, 4,400 feet of the channel and a portion of the turning basin were dredged to a depth of 10 feet at mean low water; in 1896 the turning basin was dredged and shoals which had formed at the Mud Flats and Harrisons Gut were removed; and in 1898 the channel was dredged from a point 400 feet below Cedar Point up the river for a distance of 1,900 feet, to Devils Wind Gap, and a cut 25 feet wide and 400 feet long was dredged across Spences Bar, just below the entrance to the turning basin, and the turning basin was redredged at several places where it had shoaled. The depth made in these operations was 10 feet at mean low water.

The amount expended to June 30, 1899, on the improvement of this river was $15,853.77, of which $9,853.77 was on the present project.

For the expenditure of the $2,000 appropriated by the river and harbor act of March 3, 1899, contract was made, after due advertisement, for dredging at 12.4 cents per cubic yard, place measurement, and under this contract the channel was dredged in April last to a depth of 10 feet at mean low water and 100 feet wide, a distance of 1,360 feet from opposite the upper side of Devils Wind Gap upstream, and the turning basin was redredged by making a cut 600 feet long on the north side and one 540 feet long on the south side, the width of cutting ranging between 35 and 50 feet, and the depth made being 10 feet at mean low water. This leaves about 450 feet of the channel at Devils Wind Gap to be dredged to the project dimensions, and the restoration of the channel at other points where it has shoaled, to complete the project.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the river was 9 feet.

The commerce of the river consists mainly of agricultural products. The business of the steamboat line for the year is reported to be 4,133 tons, valued at $211,587. The business done in the river by the numerous sailing vessels could not be obtained. It is believed that there has been no material change in the commerce since the improvements were begun, but the work done has facilitated navigation.

July 1, 1899, balance unexpended		$2,146.23
June 30, 1900, amount expended during fiscal year		1,962.79
July 1, 1900, balance unexpended		183.44
July 1, 1900, outstanding liabilities		171.05
July 1, 1900, balance available		12.39
Amount (estimated) required for completion of existing project		6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$3,600.00	
For maintenance of improvement	400.00	
		4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix J 14.)

15. Nanticoke River, Delaware and Maryland.—This river is a tidal stream, its head waters consisting of numerous branches rising mainly in the northern section of Sussex County, Del. The river flows in a south-southwesterly direction into Tangier Sound, Chesapeake Bay, and the interests for the improvement of the river center at Seaford, 36 miles from the mouth.

The river and harbor act of August 18, 1894, appropriated $5,000 for improving Broad Creek River, Delaware, and provided that as much of it as might be necessary should be used for the removal of the bar extending from the railroad bridge at Seaford toward the mouth of the Nanticoke River. With this appropriation the channel was dredged where necessary to a width of 100 feet and a depth of 9 feet at mean low water, from the south side of the railroad bridge at Seaford to a point 8,000 feet below. A previous appropriation for the Nanticoke River, in 1886, was, in accordance with the terms of the law, applied to the stream known as Broad Creek River, a branch of the Nanticoke River extending to Laurel.

The project for the improvement of the Nanticoke River is based upon a survey made in 1895, and is for a channel 9 feet deep at mean low water and 100 feet wide, the width to be increased to about 150 feet at sharp turns of the channel, the improvements to be extended to within 100 feet of the county bridge, where the proposed channel is to widen out fan shape, at an estimated cost of $13,000.

The first work done under the present project was in September and October, 1898, when the channel above the railroad bridge was widened and deepened to near the county bridge at Seaford, a distance of 1,650 feet. The depth made was 9 feet at mean low water, and the width, starting with 100 feet at the lower end, was gradually increased to a maximum of 230 feet near the county bridge, measured from the wharves there across the river. Below the railroad bridge the channel was dredged to the approved dimensions for a distance of 1,800 feet, covering the middle ground abreast of the wharves; and about 2,500 feet below the lower end of the middle ground a sharp turn in the channel was removed. The base of the cut made there was 650 feet long. The result of these operations gives a channel of the approved dimensions between the railroad and county bridges and down to deep water below, except in a bend about 2,900 feet below the railroad bridge, where, on account of a sharp turn, the channel remains to be widened.

The amount expended on this improvement to June 30, 1899, was $7,989.15, of which $2,989.15 was on the present project.

For the expenditure of the $3,000 provided by the river and harbor act of March 3, 1899, a contract was made for dredging at 12.4 cents per cubic yard, place measurement; and under this a cut ranging in width from 0 to 60 feet was made at the bend above mentioned on June 29 and 30, 1900, for a distance of 200 feet, the depth made being 9 feet at mean low water.

It is intended to continue work under this contract in widening the channel at this bend to 150 feet, and to redredge where found necessary in other parts of the river.

The maximum draft that could be carried June 30, 1900, over the shoalest part of the river under improvement was 9 feet.

The shipments for the year are reported to have been 17,221 tons, valued at $732,962. Those reported in 1898 were 18,121 tons, valued at $659,031.

July 1, 1899, balance unexpended		$3,010.85
June 30, 1900, amount expended during fiscal year		204.82
July 1, 1900, balance unexpended		2,806.03
July 1, 1900, outstanding liabilities	$190.00	
July 1, 1900, amount covered by uncompleted contracts	2,616.03	
		2,806.03

(See Appendix J 15.)

16. Broad Creek River, Delaware.—This river is a tidal stream and a tributary of the east fork of the Nanticoke River, which flows into the Chesapeake Bay.

Before improvements were commenced in 1881 the low-water depth at Laurel was 2 feet; below the town it was in some places only 1½ feet. At the close of the fiscal year 1889, when the original project was completed, at a cost of $35,000, a channel 6 feet deep at mean low water and 50 feet wide had been dredged from Bethel to Laurel, a distance of nearly 3 miles, and contributed toward making Laurel an important shipping point on the peninsula.

The project for improvement proposed in a report upon an examination made to comply with the requirements of the river and harbor act approved September 19, 1890, provides for dredging a channel 70 feet wide and 8 feet deep at mean low water from Bethel to the head of navigation at Laurel, at an estimated cost of $15,000.

In 1893 the channel was dredged to the approved dimensions from a point 1,000 feet above the bridge at Bethel to about 680 feet above Hitch's upper wharf, and an additional cut, also 8 feet deep, but only 40 feet wide, was dredged for a length of 215 feet across a shoal situated just beyond the section of the channel that had been dredged to the full width.

The river and harbor act of August 18, 1894, appropriated $5,000 for the improvement of Broad Creek River, but this was applied, under the terms of the act, to the removal of the bar which extended from the bridge at Seaford, on the Nanticoke River, to the mouth of that river.

The next appropriation, that of $5,000 made in 1896, was for work on Broad Creek River, and with it the channel was dredged between May 11 and June 30, 1899, to the approved dimensions from a point about 300 feet above Hitch's upper wharf, upstream, for a distance of 5,060 feet. The amount expended to the close of the fiscal year 1899 was $47,463.53, of which $35,000 was expended before the adoption of the present project, and $5,000 on the Nanticoke River, as above stated.

Under contract dated September 25, 1899, for the expenditure of the $5,000 appropriated March 3, 1899, dredging was begun on May 23, 1900, at a point about 300 feet below the point where operations were suspended under the preceding contract, owing to filling in from the channel above, and the channel was dredged to a width of 70 feet to a point 600 feet above the Delaware Railroad Bridge, a distance of 3,000 feet, and thence for a distance of 500 feet to a width of but 60 feet, the depth made being 8 feet at mean low water throughout. This brings the 8-foot channel to within 500 feet of the County Bridge at the upper end of the town of Laurel. It was necessary to reduce the width at the upper end to 60 feet, as the channel there is narrow and would not bear a greater width of dredging without endangering the wharves on both sides of the river, and the width through the Delaware Railroad Bridge was made 55 feet. During the progress of this dredging an examination was made of the work done last year, and this shows that the channel has well maintained itself. The result of these operations is a good channel not less than 8 feet deep at mean low water between the towns of Bethel and Laurel.

Further operations were suspended on June 27, with the understanding that the contractors are to widen the channel to enable vessels to turn around at a point about 500 feet above the Delaware Railroad Bridge upon the completion of the dredging to be done by them on the Nanticoke River, provided the Department can in the meantime obtain the consent of the riparian owners concerned.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the river was 8 feet.

The commerce of the river as reported for 1899 is 17,976 tons, valued at $170,856. This is less than in 1898, and no statistics for prior years are available for comparison.

July 1, 1899, balance unexpended		$7,536.47
June 30, 1900, amount expended during fiscal year		3,975.60
July 1, 1900, balance unexpended		3,560.87
July 1, 1900, outstanding liabilities	$2,600.00	
July 1, 1900, amount covered by uncompleted contracts	960.87	
		3,560.87
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement in addition to the balance unexpended July 1, 1900		1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix J 16.)

17. Wicomico River, Maryland.—The portion of the river at and just below Salisbury has been under improvement by the United States since 1872. At that time the navigable channel, with a minimum depth of 8 feet at low water, extended to a point within 2 miles of Salisbury. The extreme upper portion, as far as the milldam in the heart of the town, was quite shoal, and had an average depth of only 18 inches at low tide. Between 1872 and 1885 a channel 75 to nearly 100 feet wide and 7 feet deep at low water was dredged from deep water below to the drawbridge in the town at a cost to the Government of about $50,000.

The present project, based upon a survey of the river made in 1889, provides for a channel 9 feet deep at mean low water from that depth below to the drawbridge at Salisbury, the width to be from 100 to 150 feet, at an estimated cost of $23,200.

At the time this project was adopted there existed a 7-foot low-water channel from 75 to 100 feet wide to Salisbury. In the winter of 1891–92 the channel was deepened to 9 feet below mean low water for a width of 30 feet between the bridge at Salisbury and a point about 100 feet above Goose Island wharf, a distance of 9,250 feet. In the winter of 1893–94 the channel was dredged to the project dimensions from the bridge at Salisbury to a point 3,930 feet below, and in 1895 the channel was dredged for a farther distance of 1,800 feet. In 1898 the channel was dredged to the project dimensions from Williams Point to Goose Island wharf, a distance of 2,750 feet, and above Williams Point, where the channel previously dredged had shoaled and narrowed considerably, six cuts, 25 feet wide and aggregating 2,925 feet in length, were dredged to the approved depth. This completed the dredging that could be done with the appropriation, and the contract for this improvement was closed September 9, 1898.

The amount expended by the General Government to June 30, 1899, in the improvement of this river was $72,930.02, of which $22,930.02 had been expended on the present project.

The dredging covered by the project has been completed, but an examination of the river made upon the completion of these operations showed that owing to the shoaling of the channel during the progress of the work dredging of about 41,200 cubic yards would be necessary to restore it to the project dimensions. The estimate submitted herewith is for the dredging now required on that account, no provision for maintenance having been made in the original estimate.

The commerce of the river, which is quite varied, was reported in 1891, before the improvement on the present project was begun, as 36,262 tons, valued at $657,745. That reported for 1899 is 252,292 tons, valued at $4,028,018.

The maximum draft that could be carried, June 30, 1900, at mean low water, over the shoalest part of the channel was 9 feet, the project depth, for a width of 40 feet.

July 1, 1899, balance unexpended	$269.98
June 30, 1900, amount expended during fiscal year	267.98
July 1, 1900, balance unexpended	2.00
Amount (estimated) required for completion of existing project	6,798.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	6,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J 17.)

18. Manokin River, Maryland.—Before improvements were commenced in 1891 the depth of water at the mouth of the river at the so-called "Mud Flats" was between 1 and 2 feet at low tide. These flats are about 2½ miles wide, and made navigation impossible except at high water, thereby rendering the upper part of the river, which has a very fair depth and width, almost useless for extensive shipping purposes. The average rise of the tide at the flats is 2.6 feet.

This project was adopted in 1890 and is based upon a survey made in August and September, 1889. It provides for a channel 6 feet deep at mean low water and 100 feet wide from Locust Point to Sharps Point, a distance of about 2½ miles and embracing the section called the "Mud Flats," at an estimated cost of $30,000.

In 1891 a cut 30 feet wide and 5 feet deep at mean low water was made for a distance of 13,515 feet between Locust Point and Sharps Point, and in the upper river, above Sharps Point, several abrupt points were removed and navigation upon the whole river thereby greatly improved. In 1892–93 the cut previously made at the mouth was partly redredged and the whole widened to 60 feet. The depth made was 6 feet at mean low water. In 1895 the channel was redredged to a depth of 6 feet at mean low water and widened to 80 feet for a length of 3,520 feet.

The amount expended on the improvement to June 30, 1899, was $18,975.

Widening of the 60-foot cut at the mouth was continued under contract in July of the past year for a length of 700 feet, and the channel previously made was redredged for a distance of 2,175 feet; and in the upper river the channel was dredged to a depth of 6 feet at mean low water from that depth opposite Dashiells Creek upstream toward the county wharf for a distance of 4,940 feet, the width made being 50 feet. This latter work was done under the terms of the act making the appropriation. At the close of these operations there was a channel 6 feet deep from Sharps Point to about a mile above Dashiells Creek and a slightly less depth to the steamboat wharf above. At the mouth a cut 6 feet deep had been dredged for a length of 13,515 feet, of which 4,220 feet was 80 feet wide and the remainder 60 feet wide. Between Cockerill Point and Locust Point, where the work on the project originally began, the channel had shoaled to 4 feet, and above that year's limit of dredging operations the channel for a distance of 1,600 feet had a depth at its shoalest point of about 3 feet.

The river and harbor act of March 3, 1899, appropriated $1,500 for continuing this improvement, and for the expenditure of this a contract has been made for dredging at 12.4 cents per cubic yard, place measurement. This contract includes other points along the eastern shore of Chesapeake Bay, the entire work to be completed by December 1, 1900.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the channel between Locust Point and Sharps Point was 3 feet, and in the river to the steamboat wharf it was about 6 feet.

The tonnage in 1891, when work was begun on this improvement, was 144,058 tons, and its valuation $2,282,630. Commercial statistics, stated to be incomplete, for 1896, give a tonnage of 59,704 and a valuation of $2,124,628. None have been received for 1899.

July 1, 1899, balance unexpended	$5,525.00
June 30, 1900, amount expended during fiscal year	3,848.28
July 1, 1900, balance unexpended	1,676.72
July 1, 1900, amount covered by uncompleted contracts	1,500.00
July 1, 1900, balance available	176.72
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	7,000.00

(See Appendix J 18.)

19. Pocomoke River, Maryland.—This river has been under improvement by the General Government since 1878. In 1879 and 1880 $12,500 was expended on work below Snow Hill, chiefly in the rectification of the channel by the turning off of sharp angles and giving increased width, the depth of excavation being to 7 feet at mean low water; and in 1888, with an appropriation of $8,000, a cut-off was made through the low neck of land forming four abrupt bends just below Snow Hill. At the close of these operations there was a channel not less than 80 feet wide and 7 feet deep between Snow Hill and Shad Landing, a distance of about 4½ miles.

The present project is based upon a survey made in 1894–95, and is for dredging the channel between Snow Hill and Shad Landing to a depth of 9 feet at mean low water and a width of from 100 to 130 feet, at an estimated cost of $14,000.

With the appropriation of $5,000 made by the river and harbor act of June 3, 1896, the channel was dredged in 1897 at nine places between

Nassawango Creek and the county wharf at Snow Hill, resulting in a 9-foot channel at mean low water, the width varying between 80 and 130 feet. No work was done during the past fiscal year. The amount expended for the improvement of this river to June 30, 1899, was $24,987.26, of which $20,500 was on a former project.

The maximum draft that could be carried June 30, 1899, at mean low water over the shoalest part of the river under improvement was 9 feet.

For the expenditure of the $3,000 appropriated by the river and harbor act of March 3, 1899, a contract for dredging has been made at 12.4 cents per cubic yard, place measurement. The contract includes other places along the eastern shore of Chesapeake Bay, and the dredging is to be completed by December 1, 1900.

The commerce consists mainly of agricultural products. The business of the steamboat line to and from points on the river for the year 1899 is reported to have been 50,866 tons, valued at $1,644,021. That reported in 1898 was 45,742 tons, valued at $1,325,924.

July 1, 1899, balance unexpended		$3,512.74
June 30, 1900, amount expended during fiscal year		378.43
July 1, 1900, balance unexpended		3,134.31
July 1, 1900, amount covered by uncompleted contracts		3,134.31
Amount (estimated) required for completion of existing project		6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$4,000.00	
For maintenance of improvement	500.00	
		4,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix J 19.)

20. *Removing sunken vessels or craft obstructing or endangering navigation.*— *Wreck of schooner Mary L. Bird.*—This was an old wooden vessel 52 feet long and 18 feet beam and was sunk in July, 1899, in Little Creek, Delaware, at a point about 1 mile below Little Creek Landing. The wreck was removed between March 28 and April 2, 1900, and the débris placed ashore above high water, at a cost of $325.71.

Wreck in Cambridge Harbor, Maryland, abreast of S. L. Webster & Sons' wharf.—This was the bottom frame and lower side planking of an old flat-bottom boat, 30 feet long and about 7 feet beam. This was removed April 19 and 20, 1900, by breaking it up and placing the broken parts ashore above high water, at a cost of $44.31.

Wreck of schooner Wm. H. Roach.—This is an old schooner 53½ feet long, 16 feet beam, and 5½ feet draft, lying sunk between Fishing and Maddox islands in the Manokin River, Maryland. The vessel was beached and abandoned in a cove near by last summer, but during the following winter was carried away by the ice and dropped in the place where she now lies, making it a dangerous obstruction. Contract for its removal was approved July 24, 1900.

Wreck of bugeye Columbia.—This is a wooden vessel built in 1892, 63 feet long, 22 feet beam, and 5 feet draft, and was wrecked in February, 1900, near the steamboat wharf at Deals Island, where she now lies in 8 feet of water at low tide. Contract for its removal was approved July 24, 1900.

(See Appendix J 20.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local officer, Gen. William F. Smith, United States agent, major of engineers, U. S. A., retired, and reports thereon submitted through the Division Engineer, Col. Peter C. Hains, Corps of Engineers:

1. *Preliminary examination and survey of St. Jones River, Delaware.*—General Smith submitted reports dated May 8 and November 29, 1899, respectively. He presents a project for improvement at an estimated cost of $47,074.50, and states that such improvement is warranted by the commerce of the river, in which view the division engineer concurs. The reports were transmitted to Congress and printed in House Doc. No. 166, Fifty-sixth Congress, first session. (See also Appendix J 21.)

2. *Preliminary examination and survey of Elk River, Maryland.*—General Smith submitted reports dated May 8 and November 13, 1899, respectively, with plan for improvement at an estimated cost of $16,665 and $2,500 annually for maintenance. In the opinion of General Smith, concurred in by the division engineer, this expenditure is justified by the commercial interests involved. The reports were transmitted to Congress and printed in House Doc. No. 105, Fifty-sixth Congress, first session. (See also Appendix J 22.)

3. *Preliminary examination and plan and estimate for improvement of Rockhall Harbor, Maryland, with a view to obtaining a channel through Swan Point Bar and in the inner harbor.*—General Smith submitted report dated April 24, 1899. The cost of a channel 150 feet wide and 12 feet deep through Swan Point Bar is estimated at $23,925, and in the inner harbor at $19,140. The biennial cost of maintenance is estimated at $8,320 and $888, respectively. A channel 190 feet wide and 12 feet deep is estimated to cost $31,515, and $8,320 every two years for maintenance. General Smith considers the locality worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 99, Fifty-sixth Congress, first session. (See also Appendix J 23.)

4. *Preliminary examination and survey of Queenstown Harbor, Maryland.*—General Smith submitted reports dated March 22 and October 30, 1899, respectively. He presents a plan for improvement at an estimated cost of $23,100, and states that the locality is worthy of improvement by the General Government, in which view the division engineer concurs. The reports were transmitted to Congress and printed in House Doc. No. 92, Fifty-sixth Congress, first session. (See also Appendix J 24.)

5. *Preliminary examination and survey of Claiborne Harbor, Maryland.*—General Smith submitted reports dated June 1 and October 26, 1899, respectively, with plan for improvement at an estimated cost of $17,490. A conditional estimate of $2,500 for extension of existing jetty is also submitted. The locality is considered by the local officer and the division engineer to be worthy of improvement by the General Government, and I concur in their views. The reports were transmitted to Congress and printed in House Doc. No. 81, Fifty-sixth Congress, first session. (See also Appendix J 25.)

6. *Preliminary examination and survey of Tyaskin (Wetipquin) Creek, Maryland.*—General Smith submitted reports dated March 23 and November 14, 1899, respectively, with plan for improvement at an estimated cost of $13,200. The local officer is of opinion that the locality is worthy of improvement by the General Government, and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 109, Fifty-sixth Congress, first session. (See also Appendix J 26.)

7. *Preliminary examination for dredging channel leading to Tangier Island, in Tangier Sound, Virginia.*—General Smith submitted report dated May 9, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 42, Fifty-sixth Congress, first session. (See also Appendix J 27.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Smyrna River, Delaware, with a view to securing two short cross-cuts to shorten the distance from the head of navigation to Delaware Bay.*
2. *Mispillion River, Delaware, from its mouth to the head of navigation,*
3. *Harbor at Havre de Grace, Md., with a view to the removal of rocks near the entrance.*
4. *Mahon Harbor, Delaware.*

IMPROVEMENT OF PATAPSCO RIVER AND BALTIMORE HARBOR, MARYLAND.

This district was in the temporary charge of Lieut. Charles W. Kutz, Corps of Engineers, to April 14, 1900, and in the charge of Lieut. Col. O. H. Ernst, Corps of Engineers, since that date, with Lieutenant Kutz under his immediate orders. Division Engineer Col. Peter C. Hains, Corps of Engineers, from October 27, 1899, to April 14, 1900.

1. *Patapsco River and channel to Baltimore, Md.*—Before work was begun the controlling depth from the Chesapeake Bay to Fort McHenry, Baltimore Harbor, was 17 feet. The improvement was commenced in 1853 with a project to obtain a depth of 22 feet at mean low water and a width of 150 feet from Fort McHenry to the deep water in the Chesapeake Bay off Swan Point. There have been three succeeding projects, but each one has been for increasing the dimensions of the channel and making some modifications in the direction or location of it. The project of 1853 was followed by another in 1871 to increase the width to 400 feet at the lower end of the channel, graduated to 250 feet at the upper end; to deepen it to 24 feet at mean low water, making a change in direction by abandoning the lower part of the Brewerton division and intersecting it south of North Point with a new cut, called the Craighill channel, leading to the deep water off Sandy Point, thus shortening the distance and reducing the cost of

maintenance. The 24-foot channel was completed in 1874. This was followed March 3, 1881, with a project to increase the depth to 27 feet at mean low water and the width to 600 feet, except at the angles, where it was to be over 1,200 feet, and to make another change in direction by excavating a cut-off connecting the Brewerton and Craighill divisions, which would reduce the distance. That improvement was accomplished in 1892, and appropriations amounting to $100,000 followed to maintain it. The act of June 3, 1896, authorized the existing project, which is to increase the depth to 30 feet at mean low water, to give a bottom width of 600 feet, widened in the bends, the side slopes to be three base to one vertical, at an estimated cost of $2,500,000 and an annual expenditure of $50,000 for maintenance, but as explained in the Annual Report of the Chief of Engineers for 1899 (p. 203) the full amount of the estimate will probably not be required.

Under the existing or 30-foot project the Fort McHenry, Brewerton, and Craighill divisions had been dredged to a width of 230 feet, and the Cut-off division to 250 feet, when the act of March 3, 1899, authorized a contract for $1,000,000, to obtain the channel of the project. Accordingly a continuing contract was entered into and work commenced under it September 12, 1899. The dredging in the fiscal year has amounted to 1,959,773 cubic yards of material, and has resulted in making the Fort McHenry division from 330 to 480 feet wide; the Brewerton division from 275 to 320 feet wide; the Cut-off division from 290 to 450 feet wide, and the Craighill division from 330 to 380 feet wide, and there is now a maximum draft of 30 feet at mean low water that can be carried over the shoalest portions from the Chesapeake Bay to Baltimore Harbor.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1899, was $3,697,105.27.

The contractor expects to complete the contract by December 31, 1901, which will require an appropriation of $475,352 to meet payments under it. The amount of the appropriation required is arrived at as follows: The continuous contract authorized was for $1,000,000. Appropriations have already been made for $524,648 to make payments under it, leaving a balance of $475,352 still to be appropriated. In accordance with the adopted project, an appropriation of $50,000 will also be required for maintenance for the fiscal year ending June 30, 1902.

The tonnage movement of the port has been as follows:

Fiscal year ending June 30—	Tons.
1889	3,243,017
1890	4,237,361
1891	4,495,469
1892	5,224,042
1893	4,607,176
1894	4,752,946
1895	4,794,964
1896	5,363,894
1897	6,868,120
1898	7,339,405
1899	6,843,620
1900	7,941,580

The following table will illustrate the statistics of the port during the fiscal year ending June 30, 1900:

Dutiable imports have increased	$2,501,369.00
Free imports have increased	$7,390,453.00
Domestic exports have increased	$8,332,966.00
Tonnage (foreign) has increased ... tons..	108,360
Duties collected have increased	$748,772.76
Duties on merchandise in bond have decreased	$61,669.70
Duties on merchandise in bond, with and without appraisement, have increased	$1,936.27

July 1, 1899, balance unexpended		$218,924.73
Amount appropriated by sundry civil act approved June 6, 1900		324,648.00
		543,572.73
June 30, 1900, amount expended during fiscal year		110,906.44
July 1, 1900, balance unexpended		432,666.29
July 1, 1900, outstanding liabilities	$2,000.00	
July 1, 1900, amount covered by uncompleted contracts	730,969.02	
		732,969.02

Amount (estimated) required for completion of existing project		1,575,352.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$475,352.00	
For maintenance of improvement	50,000.00	
		525,352.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix K 1.)

2. *Channel to Curtis Bay, in Patapsco River, Baltimore Harbor, Maryland.*—Curtis Bay, about 4 miles below Baltimore, had a natural depth of 22 feet at mean low water. Owing to the crowded conditions in the main harbor at Baltimore commerce is seeking an outlet there. It required deepening and connecting with the main ship channel to make it available for deep-draft vessels using the port.

The original and only project is to be found in the Annual Report of the Chief of Engineers for 1893, page 1249, and is for a channel 27 feet deep at mean low water and 150 feet wide at bottom, from the main ship channel in the Patapsco River to Curtis Bay, at an estimated cost of $85,000. The project width was obtained in 1893, but the depth lacked 2 feet. This answered the needs of navigation until 1899, when a decided movement of commerce to Curtis Bay indicated that the full project depth should be given. Accordingly a contract was made for the expenditure of the balance available, amounting to $12,000, and with those funds 97,641 cubic yards of material was removed in the fiscal year ending June 30, 1900, making the channel 27 feet deep at mean low water for a width of 70 feet.

The amount expended up to the close of the fiscal year ending June 30, 1899 was $28,000.

Curtis Bay is in the collection district of Baltimore.

July 1, 1899, balance unexpended	$12,000.00
June 30, 1900, amount expended during fiscal year	11,861.93
July 1, 1900, balance unexpended	138.07
July 1, 1900, outstanding liabilities	138.07

Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of June 4, 1897.

(See Appendix K 2.)

3. *Harbor of southwest Baltimore (Spring Garden), Md.*—In its original condition the navigable channel way had a controlling depth of 15 feet at mean low water in one portion. although the depth was greater in others. The width was contracted, but varying, the least being

about 100 feet. Navigation was not available for the deep-draft vessels of the port of Baltimore.

The originally adopted project (Annual Report of the Chief of Engineers for 1896, pp. 1005–1007) was for a channel 27 feet deep at mean low water, 100 feet wide at bottom, with side slopes of 1 on 3, from the main ship channel near Fort McHenry to the foot of Eutaw street, with a turning basin 400 by 400 feet near the upper end, at an estimated cost of $314,000.

There had been no expenditures up to the close of the fiscal year ending June 30, 1899.

The condition of the improvement June 30, 1899, was as stated in the first paragraph.

There were no operations in the fiscal year ending June 30, 1900, the appropriation of $5,000, in the act of June 3, 1896, being too small to accomplish any useful result.

This harbor is in the collection district of Baltimore, and the commercial statistics of that port include it.

July 1, 1899, balance unexpended	$5,000.00
July 1, 1900, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	309,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	88,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K 3.)

4. Removing sunken vessels or craft obstructing or endangering navigation.—(*a*) The canal boat *Hero* sunk and was abandoned in the Chesapeake Bay, off Pooles Island, in 18 feet of water, where she was an obstruction to navigation. With the assistance of the U. S. steam tender *Sentinel* and the use of dynamite the wreck was entirely removed January 17–20, 1900, at a cost of $150.

(*b*) The schooner *Cecil*, sunk in the Patapsco River, near the main ship channel, was an obstruction to navigation and was abandoned. The dredge *Defender*, which was working in the vicinity, raised the wreck, carried it to Baltimore, and beached it inside the pierhead line at a cost of $50.

The total amount expended during the year on removal of wrecks was $200.

(See Appendix K 4.)

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES; OF JAMES RIVER AND OF HARBOR AT MILFORD HAVEN, VIRGINIA, AND OF CERTAIN RIVERS IN VIRGINIA ON THE WESTERN SHORE OF CHESAPEAKE BAY; PROTECTION OF JAMESTOWN ISLAND, VIRGINIA.

This district was in the charge of Lieut. Col. Chas. J. Allen, Corps of Engineers.

1. Potomac River at Washington, D. C.—The Potomac River is navigable for vessels, both steam and sail, from its mouth to Georgetown, D. C., a distance of 113 miles. At Washington it changes its character from a distinctly fluvial to a tidal stream. The tide rises as far up as Little Falls, 3 miles above Georgetown, but the flood current is not perceptible above the latter. The mean range of tides at Washington is 3 feet.

At Little Falls, the actual head of navigation, the width of the river at low tide is 150 feet. The width just above the Aqueduct Bridge, which crosses the river at Georgetown, is about 1,200 feet. Below this bridge, along the water front at Georgetown, the width of the river gradually decreases for a distance of one-half mile to the foot of Thirty-first street, where the width is 730 feet. This part of the river is known as Georgetown Harbor, and its navigation was formerly obstructed by several dangerous rocks, which were removed in 1876 and 1883–1885. The depth obtained over these rocks by the improvement was 20 feet at low tide, which is now the ruling depth in the harbor. Georgetown has a wharf frontage of 4,000 feet, extending from the Aqueduct Bridge to the mouth of Rock Creek. At Easbys Point, 1 mile below the bridge, the river width is 974 feet. Prior to the reclamation of the flats the width of river sharply increased from Easbys Point to about 6,000 feet off the foot of Seventeenth street, about four-fifths of a mile below, and this last-named width substantially continued to Giesboro Point, nearly 4 miles below Easbys. Over a great part of this width there was a large deposit of the sediment carried by the river, resulting in the formation of bars in the channel and of wide flats on the left bank.

There were, in 1792, three channels in this part of the river, but since 1834 there have been but two, viz, the main, formerly called the Georgetown, but now known as the Virginia Channel, and the Washington Channel.

Long Bridge, 1¼ miles below Easbys Point, crosses both channels. The Virginia Channel was obstructed by two bars. The upper bar extended from Long Bridge to about one-half mile below Easbys Point. The ruling depth on this bar was 8 feet in 1857, while in 1871 it was 10 feet, in 1873 it was 13½ feet, and in 1881, 15 feet. The improvement was due to frequent dredging, but after every freshet the dredged channel was nearly obliterated. The lower bar, 3,200 feet long, was near Giesboro Point, and in 1874 had a ruling depth of 14 feet, which was increased by dredging in 1874–75 to 16 feet. This was the ruling depth in 1881. Between these two bars the channel had depths of 20 to 30 feet. Below Long Bridge the Washington Channel was shoal; its ruling depth in 1878 was 10 feet for the greater part of the wharf front. Off the foot of N street the depth increased to 12 feet, thence gradually deepened to 22 feet off Greenleaf Point, where the Anacostia River enters the Potomac.

The depth in the Washington Channel had been increased by dredging, so that in 1881 a depth of 16 feet could be found along the greater part of the wharf front.

The flats, which, under the conditions above noted, had, prior to the present project, been in gradual process of formation for a long time, extended from the Washington shore to the edge of the Virginia Channel. Between Easbys Point and the old Seventeenth street wharf a large area, in some places 1,500 feet wide, had been raised by accretions to a height of about a foot above mean low tide. Large quantities of sewage were carried at high tide over these flats and distributed by the flow among the rank growth of sedges and aquatic plants with which the flats were covered. As the tide fell this mass of sewage was left exposed to the rays of the sun. These conditions combined to generate effluvia which rendered the adjacent portions of the city almost uninhabitable, and at the same time were reported as causing malarial and other diseases.

The present, which is the original, project for improvement, was adopted by the act of Congress of August 2, 1882. It has for its object the improvement of the navigation of the river by widening and deepening its channels, reclamation of the flats by depositing on them the material dredged from the channels, the freeing of the Washington Channel, so far as it can be done, of sewage, and the establishment of harbor lines beyond which no wharves shall be built. To effect these the project provided for 20 feet depth in the channels at low water, for filling in the flats to a height of 3 feet above the flood plane of 1877, and for a tidal reservoir or basin above Long Bridge, to be provided with inlet and outlet gates of ample dimensions, to work automatically, and so arranged as to admit of the basin being filled from the Virginia Channel on the flood tide and discharged into the Washington Channel on the ebb. An ample system of drainage for the reclaimed area was also contemplated.

A training dike on the Virginia shore, extending downstream from the foot of Analostan Island, was added to the project in 1890.

The project also provides for the rebuilding of Long Bridge at an early period during the progress of the improvement, with wide spans upon piers offering the least possible obstruction to the flow of the water, and the interception of all sewage now discharged into the Washington Channel and its conveyance to the James Creek sewer canal, but neither of these works was included in the estimated cost of the improvement, which was $2,716,365. The estimate, as revised in 1897, is $2,953,020.

The total of appropriations for this work, from August 2, 1882, to March 3, 1899, is $2,359,000.

The amount expended to the close of the fiscal year ending June 30, 1899, was $2,206,718.29.

The expenditure resulted in the dredging of a channel 20 feet deep and 550 feet wide through the bar above Long Bridge and in restoring the standard 20-foot navigation by redredging shoals due to freshets; in increasing the width of the natural channel just below Long Bridge by 50 to 500 feet and in deepening it to 20 feet; in dredging a channel 350 feet wide and 20 feet deep through the bar in the Virginia Channel near Giesboro Point; in dredging the Washington Channel to a width of 400 feet and a depth of 20 feet for a navigation channel, and in dredging between this navigation channel and the wall of the adjacent reclaimed area to a depth of 12 feet; in dredging at the junction of the Washington and Virginia channels; in dredging the tidal reservoir (1 1 acres) to a depth of about 8 feet; in the construction of the reservoir outlet, and in the construction of 35,289 linear feet of sea wall, of which 4,910 linear feet have been taken down and relaid, and 5,965 linear feet of training dike.

The total number of cubic yards of material dredged from the channels, from the commencement of the improvement (1882) to date, and deposited on the flats is about 10,893,607 cubic yards.

The area of land reclaimed by these operations is 621.12 acres (or including reservoirs, 739.42 acres), which by act of March 3, 1897, was declared to be a public park, under the name of Potomac Park.

During the past fiscal year the dredging by Mr. Clegg was continued slowly and at irregular intervals up to December 22, 1899, when the work was suspended by the contractor and was not resumed. On April 7, 1900, he discontinued the contract, which was accordingly annulled May 9, 1900. Eighty thousand three hundred and eighty-six cubic yards of material was dredged and deposited upon the flats during the year.

The expenditures of the fiscal year were for widening and deepening part of Virginia Channel above Long Bridge and adding to the deposit for reclamation of the flats.

The slowness of dredging operations, however, has permitted a shoaling of a part of the channel above the bridge, so that the maximum draft at mean low tide which could be carried over this the shoalest part of the improvement was on June 30, 1900, 15 feet. A short bar has also recently formed at the entrance to the Washington Channel, the maximum draft over which at the same stage is 17 feet. With these exceptions the Washington Channel has a depth of 20 feet, and the Virginia Channel the same, after leaving the bar above Long Bridge. It is expected to remove these shoals under a new contract during the coming fiscal year.

The benefits to navigation from the improvements have been marked. Vessels can come to Washington loaded more heavily than was formerly the case. The value of the commerce to be benefited may be judged of by examination of the following table, showing the commerce of the port of Washington, in tons, from 1887 to 1899, inclusive:

	Tons.		Tons.
1887	618,972	1894	644,588
1888	581,575	1895	693,450
1889	488,680	1896	723,657
1890	519,696	1897	593,684
1891	551,219	1898	645,239
1892	766,954	1899	715,549
1893	653,433		

The items of work remaining to be completed are as follows: The dredging and redredging of the Virginia Channel, the redredging of the Washington Channel, and the raising of the remainder of the reclaimed area to the required height, the dredging of the tidal reservoir, the completion of the sea wall, the construction of the reservoir inlet, and the completion of the training dike on the right of the Virginia Channel above Long Bridge.

Five hundred linear feet of sea wall will have to be built at the northeast corner of the tidal reservoir in case the bathing beach shall ever be discontinued.

The sum of $200,000 can be profitably expended during the fiscal year ending June 30, 1902, in dredging the tidal reservoir, building the inlet gates, dredging the channels of the Potomac and depositing the dredging material, and extending the dike.

July 1, 1899, balance unexpended	$152,281.71
June 30, 1900, amount expended during fiscal year	22,385.53
July 1, 1900, balance unexpended	129,896.18
July 1, 1900, outstanding liabilities	221.00
July 1, 1900, balance available	129,675.18
Amount (estimated) required for completion of existing project	594,020.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L 1.)

2. Potomac River below Washington, D. C.—The river and harbor act approved March 3, 1899, contained the following item:

> Improving Potomac River at and below the city of Washington, District of Columbia, one hundred thousand dollars: *Provided,* That the Secretary of War may enter into a contract or contracts for the materials and work necessary for the completion of the improvements below the city of Washington, in accordance with the project submitted November sixth, eighteen hundred and ninety-one, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one hundred and fifty thousand dollars, exclusive of the amount herein and heretofore appropriated.

The project mentioned in this item of the act is printed in the Annual Report of the Chief of Engineers for 1892, page 1070, and contemplates, besides the work at Washington, dredging at the Kettle Bottom Shoals; near Maryland Point; near Smiths Point, and at Mattawoman Shoal, near Deep Point, to secure a depth of 24 feet at low tide, the estimated cost of the work at the four shoal places below Washington being $158,400.

Following are brief descriptions of the condition of each of the shoals as contained in the project of 1891:

1. Kettle Bottom Shoals.—The Kettle Bottom Shoals, which are the first obstruction to 24-foot navigation met in ascending the river, commence 37 miles from the mouth and extend from Cob Point to Lower Cedar Point, a distance of 12 miles. They consist of small shoals, old oyster beds, underlaid with mud, over which are depths of from 10 to 16 feet, scattered over the river in an irregular fashion, making navigation difficult for vessels drawing over 16 feet. There is, however, an old channel near the north bank of the river through which 24 feet can be carried except for a short distance near Swan Point, where there is a small shoal with a ruling depth of 23 feet.

2. Maryland Point Shoal.—The next obstruction is Maryland Point Shoal, near Maryland Point, and 67 miles from the mouth. It is 7,000 feet in length, has a ruling depth of 22 feet, and is composed of soft mud.

3. Smiths Point Shoals.—Near Smiths Point are two shoals. The lower, commencing about one-half mile above Maryland Point Shoal, is about 4,500 feet long, has a ruling depth of about 23 feet, and is composed of soft mud. About one-half mile above Smiths Point the upper shoal commences. It is 4,500 feet long, has a ruling depth of 21 feet, and is composed of soft mud.

4. Mattawoman Shoal.—After passing Upper Smiths Point Shoal no obstruction to 24-foot navigation is found until Mattawoman Shoal is reached, 82 miles above the mouth of the river. This shoal is 15,300 feet long and has a ruling depth of 19.5 feet. The lower part is composed of sand and gravel, underlaid with mud, and the upper part of mud.

At the close of the fiscal year ending June 30, 1899, no expenditure had been made, and there was consequently no change from the conditions above stated.

During the fiscal year ending June 30, 1900, proposals were invited for dredging, a contract was made for the entire work, and dredging begun at Mattawoman Shoal March 26, where it was in progress at the close of the year. This is the shoalest of the obstructions below Washington, and the maximum draft that could be carried over it on June 30, 1900, was 19½ feet, the dredge not having completed its work at this shoal.

During the progress of dredging at Mattawoman Shoal what appeared to be partly disintegrated ledge rock in considerable quantities was encountered. This was totally unexpected, the survey of 1891 not having discovered it. Removal of ledge rock or of large bowlders is not contemplated by the terms of the present contract. Its removal may cost about 50 cents per cubic yard in excess of the contract price per yard for removal of material. The quantity of ledge rock and bowlders at Mattawoman Shoal requiring removal is approximately estimated as 60,000 cubic yards. Should ledge rock and large bowlders be encountered at the other shoals in the same proportion to the material to be dredged from them as is found at Mattawoman, the total amount for all the shoals—Mattawoman Shoal included—may be approximately given as 120,000 yards, and the cost of removal of the same as about $60,000, thus increasing the cost of the work above what is represented by the contract now in force.

The engineer officer in charge estimates $80,400 (the difference between the estimate of 1891 and the sum of the allotment of $26,000 made from the appropriation of March 3, 1899, added to the appropriation of $52,000, June 6, 1900—$78,000) as the additional amount that should be available for completion of the work.

July 1, 1899, balance unexpended		$26,000.00
Amount appropriated by sundry civil act approved June 6, 1900		52,000.00
		78,000.00
June 30, 1900, amount expended during fiscal year		11,858.72
July 1, 1900, balance unexpended		66,141.28
July 1, 1900, outstanding liabilities	$112.00	
July 1, 1900, amount covered by uncompleted contracts	57,983.00	
		58,095.00
July 1, 1900, balance available		8,046.28
Amount (estimated) required for completion of existing project		80,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		80,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix L 2.)

3. Occoquan Creek, Virginia.—Occoquan Creek is a tributary of the Potomac River, which it enters about 25 miles below Washington, D. C. The stream is navigable from its mouth, at Sandy Point, to the town of Occoquan, a distance of 4 miles. Navigation was obstructed by four bars, which were improved between 1873 and 1880 by dredging and dike construction so as to secure a navigable depth of about 6 feet at low tide. Four appropriations were made from 1873 to 1878, amounting to $25,000, and in 1880 the improvement was regarded as completed. In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey of the creek was made in 1889. The survey showed that of the channels dredged through Lower Mud, Upper Mud, Sand, and Occoquan bars, all, excepting that dredged through Upper Mud Bar, had filled in from 2 to 3 feet in depth since 1880. The act of September 19, 1890, appropriated $10,000 for improving the creek.

The project adopted December 5, 1890, for the new (present) improvement comprises dredging of channels 6 feet deep and from 100 to 150 feet wide through the four bars, and construction of dikes required to secure the depths obtained by dredging. Estimated cost of the project, $45,000.

The total of appropriations for the improvement from September 19, 1890, to and including March 3, 1899, is $25,000.

The amount expended to include June 30, 1899, was $22,557.95. It resulted in dredging channels from 100 to 150 feet in width and to a least depth of 6 feet through the four bars, and in construction of 1,585 linear feet of dike at Occoquan Bar and Sand Bar.

During the past fiscal year the channel through the Lower Mud Bar was restored to its full width of 100 feet and depth of 6 feet at low tide by dredging done in November, 1899. The maximum draft that could be carried through the channel on June 30, 1900, at low tide was 6 feet, and the width of the channels between 6-foot contours was 100 feet. No dike work was done during the year.

The work remaining to be done to complete the project is extension of the dike at Sand Bar, construction of a dike at Upper Mud, and such dredging as may be necessary to restore the channel dimensions called for by the project. Owing to the action of freshets in the upper part, and to the great width of the lower part of the stream, and cross-tidal currents in the latter, it is probable that occasional redredging will be required to maintain the depth even after the essential features of the project shall be completed. The project is not, therefore, regarded as capable of permanent completion as regards dredging.

The sum of $4,000 can be profitably expended during the fiscal year ending June 30, 1902, in extension and construction of dikes, and in dredging.

The work done under the appropriations for this improvement has been of material benefit to the trade and commerce connected with this locality by increasing the original ruling depth of 3 feet at low tide to 6 feet, thus obviating the delays due to waiting for tides and increasing the available draft of vessels navigating the creek. In this connection attention is invited to the comparative table of commercial statistics appended to this report. The articles carried through the channel are mostly sand (for building), railroad ties, piles and wood, coal, fertilizers, flour and grain, and miscellaneous articles, being small in amount.

Receipts and shipments by water.

	Tons.		Tons.
1891	8,205	1897	15,835
1892	56,705	1898	29,865
1894	8,900		
1895	10,475	Total for seven years	171,655
1896	41,670		

Of the total tonnage 92,600 tons were sand.

Repeated efforts were made to obtain commercial statistics for 1899, but they could not be procured.

July 1, 1899, balance unexpended	$2,442.05
June 30, 1900, amount expended during fiscal year	2,037.91
July 1, 1900, balance unexpended	404.14
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 3.)

4. Nomini Creek, Virginia.—Nomini Creek enters the Potomac River from the right bank about 82 miles below Washington. In 1872 its navigation was obstructed by a bar of oyster shells and sand at its mouth, over which but 3 feet could be carried at low tide. There was a strong cross current just within the mouth. After passing the bar the stream widens, and 8 feet can be carried for about 3½ miles to Nomini Ferry, while 5 feet can be carried for about 6 miles above the mouth.

The project for improvement, adopted in 1873, provided for dredging a channel through the bar 100 feet wide and 9 feet deep. The width was increased to 150 feet in 1879, in order to meet the increased trade. In 1885 the project was again modified by increasing the proposed width to 200 feet, at a cost of $62,500. In 1888 the estimate was increased to $72,500, the channel having shoaled on account of suspension of work from 1883 to 1889. It was difficult to secure permanent results, the channel being exposed to north and northwest winds and to cross-tidal currents. The deterioration of the channel outside White Point was thought to be largely due to material carried into the channel by the flood and ebb currents of Currioman Bay. In order to maintain the channel, the project was modified in 1890 to embrace the following: The dredged channel to be 150 feet wide and 9 feet deep; a jetty to be constructed from White Point on the east and one from Cedar Island on the west; dikes to be built inside White Point to check the cross currents. Estimated revised cost, $72,500. Examination made in 1897 showed that the east jetty should be made 400 feet longer, and that both jetties should be made higher than originally projected, the increased cost bringing the estimate up to $105,000.

The total of appropriations for the improvement up to and including March 3, 1899, is $70,000.

The amount expended to June 30, 1899 ($59,981.58), resulted in a channel 150 feet wide and 9 feet deep in the greater part of the outer channel, and the construction of 819 linear feet of the east jetty.

During the fiscal year ending June 30, 1900, the outer channel was redredged where it had shoaled, and the standard depth of 9 feet by a width of 140 and 150 feet was restored throughout the channel. This work was done by contract. The maximum depth that could be carried through the channel at low tide on June 30, 1900, was 9.7 feet.

It was the intention to raise the east jetty by contract, but the one bid received was regarded as too high and was rejected. It was then determined to do the work by hired labor. Accordingly work was begun June 5, 1900, and was in progress at the close of the fiscal year. About 130 linear feet of jetty was raised during the year.

The total of freight transported through the channels under improvement, 1889–1898, is 196,110 tons. The freight carried was coal, farm produce, grain, lumber, oysters, railroad ties, general merchandise, and wood. The tonnage, by years, is given below.

The work required for completion of the project is completion of the east jetty, construction of the west jetty, and some redredging of the channels.

The sum asked for the fiscal year ending June 30, 1902, is to be applied to jetty construction and dredging.

Tonnage by years.

	Tons.		Tons.
1889	13,542	1894	25,100
1890	15,825	1895	16,250
1891	62,300	1896	7,425
1892	[1]21,000	1897	7,370
1893	17,658	1898	9,640

Repeated efforts were made to obtain commercial statistics for 1899, but they could not be procured.

July 1, 1899, balance unexpended		$10,018.42
June 30, 1900, amount expended during fiscal year		2,055.29
July 1, 1900, balance unexpended		7,963.13
July 1, 1900, outstanding liabilities	$556.00	
July 1, 1900, amount covered by uncompleted contracts	2,005.00	
		2,561.00
July 1, 1900, balance available		5,402.13

Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 4.)

5. *Lower Machodoc Creek, Virginia.*—This creek is a tidal estuary on the right bank of the Potomac River and about 85 miles below Washington, D. C. It has a navigable length of about 4 miles. The width between banks at the mouth is 1 mile and between the 12-foot contours the channel width exceeds 3,000 feet. The lower part of the creek for a distance of 1½ miles above the mouth is three-fourths of a mile to a mile in width, with a navigable depth of 13 feet, affording a safe harbor during northeast to southeast storms.

At the Narrows, 2 miles above the mouth, the stream suddenly contracts to a width of 650 feet, and the channel is obstructed by a sand bar over which but 4 feet could be carried at low tide. This bar constituted the principal obstruction to navigation.

After passing Narrows Bar a depth of 10 to 14 feet is found in the channel, gradually shoaling to about 9 feet near Cupelo Point, 3 miles above the mouth, and thence to about 6 feet at Drum Bay, the head of navigation, 4 miles above the mouth.

The present approved project, adopted November 29, 1892, provides for dredging a channel 150 feet wide and 9 feet deep at low tide through the bar at the Narrows. The estimated cost was originally $15,000. This estimate was revised in 1897 and reduced to $11,100.

The total appropriations, to include that of $1,500 by act of March 3, 1899, is $9,000.

The total expenditures to the close of the year ending June 30, 1899, was $7,473.13. It resulted in a channel through Narrows Bar 150 feet wide and 6 feet deep on the sides, a depth of 9 feet existing over a width of from 90 to 110 feet.

During the past fiscal year the 9-foot channel was widened by dredging on the east and west sides. Owing to the small appropriation the amount of dredging was limited. Upon its completion there resulted a channel through Narrows Bar 150 feet wide and 9 feet deep for a length of about 1,150 feet (or about two-thirds of the length of the bar) and from 90 to 110 feet wide and 9 feet deep through the remainder of the bar, the sides of this latter portion being 6 feet deep for a total width of 150 feet.

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[1] This statement is for sailing vessels only. The steamers carry the great bulk of grain and merchandise.

The maximum draft that could be carried June 30, 1900, over the shoalest portion of the channel was 9 feet at mean low water.

The benefit to navigation and commerce from the work already done has been considerable, as large sailing vessels and regular lines of steamers now enter the creek, which was impossible previous to the improvement.

Repeated efforts have been made to obtain commercial statistics for this work, but without success.

The sum asked for the fiscal year ending June 30, 1902, can be profitably expended in continuance of dredging.

July 1, 1899, balance unexpended	$1,526.87
June 30, 1900, amount expended during fiscal year	1,304.74
July 1, 1900, balance unexpended	222.13
Amount (estimated) required for completion of existing project	2,100.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	2,100.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 5.)

6. *Rappahannock River, Virginia.*—The Rappahannock River is navigable from its mouth in Chesapeake Bay to Fredericksburg, Va., a distance of 106 miles. The lower part of the river has the character of a tidal estuary, the width varying from 1 to 3.5 miles. The ruling depth at the mouth is 5 fathoms, and this depth holds to Jones Point, 28 miles above, while 17 feet can be carried to within 1 mile of Tappahannock, which is 41 miles from the mouth. Above Tappahannock the river has a tortuous course, and above Port Royal, 29 miles from Fredericksburg, it flows between high banks. The width at Fredericksburg is about 350 feet, gradually increasing to about 1,500 feet at Port Royal. In 1871, prior to the inception of the improvement, 6 feet could be carried to within a mile of Fredericksburg, and thence 4 feet to the town.

The obstructions to navigation before improvement was undertaken were nine bars between Tappahannock and Fredericksburg, over which the ruling depths were from 4 to 10½ feet. The chief obstructions were in the 12½ miles of river below Fredericksburg, and where seven of the bars were found. Of these bars, Fredericksburg Bar, with a least depth of 4 feet, and Spottswood Bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The original project, approved in 1871, was to secure a channel 100 feet wide and 10 feet deep by dredging and the construction of dikes from Fredericksburg to Tappahannock, the wrecks obstructing the channel to be removed. The first estimate of the cost of this improvement was $83,760. In 1879 the project was amended so as to provide for dredging a channel 100 feet wide and 10 feet deep through the bars between Fredericksburg and Port Royal, and one 200 feet wide and 15 feet deep between Port Royal and Tappahannock, for a larger class of vessels; the depths secured by dredging to be maintained by a system of wing dams and training dikes, to be built of piles and sheet piling, or of piles and brush or logs, the dikes being also required in some cases to secure the dredged material from being carried back into the river.

The total cost of the revised project, which is the present approved project, was estimated at $381,500.

The appropriations for this work from March 3, 1871, to March 3, 1899, aggregate $267,500.

The amount expended to June 30, 1899, was $251,352.50. The work done resulted in the partial improvement of seven bars between Fredericksburg and Port Royal, by means of dredging and rock excavation, construction of dikes and removal of wrecks which obstructed navigation.

During the fiscal year ending June 30, 1900, the construction of 418 linear feet of dike at Fredericksburg Bar begun during the preceding year was completed, and dredging under contract was in progress at the close of the year at Pollock Bar, 4,435.6 cubic yards having been excavated during the year.

The work done to date has resulted in a channel affording a maximum depth at mean low tide of 8 feet to Fredericksburg and 9½ feet to within 4½ miles of that place.

The work remaining to complete the project is continuation of dredging and dike construction necessary to secure the required dimensions of channel.

The range of tide at Fredericksburg is 3 feet and at Urbana, 16 miles from the mouth, it is 1½ feet.

The value of the improvement may be inferred from an examination of the following table of commercial statistics:

Tonnage for—	Tons.	Tonnage for—	Tons.
1888	83,600	1895	[1]151,466
1890	83,830	1896	[1]161,196
1892	[1]126,333	1897	[1]158,108
1893	[1]141,750	1898	[1]166,586
1894	[1]144,070	1899	[1]167,862

The principal articles of commerce are grain, oysters, fertilizers, cattle, farm produce, and general merchandise.

At Fredericksburg Bars new deposits of sand are formed by each recurring freshet, and the annual reports for a number of years past have referred to the necessity of an annual appropriation of $7,500 for removal of such deposits. The timber dikes for regulation of the channels, built to elevations of about 6 feet above low tide, have suffered considerably from decay, and the sum of $2,500 is estimated as necessary for their repair and maintenance.

The sum of $15,000 can be profitably expended during the fiscal year ending June 30, 1902, in channel improvement in accordance with the approved project.

During the ensuing fiscal year the unexpended balance will be applied to dredging at Fredericksburg and Pollock bars (the latter about 1 mile below Fredericksburg), and to repair of dikes at the first-named bars.

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[1] Furnished by Mr. William D. Scott, Fredericksburg, Va.

July 1, 1899, balance unexpended		$16,147.05
June 30, 1900, amount expended during fiscal year		3,187.24
July 1, 1900, balance unexpended		12,960.26
July 1, 1900, outstanding liabilities	$250.00	
July 1, 1900, amount covered by uncompleted contracts	5,670.00	
		5,920.00
July 1, 1900, balance available		7,040.26
Amount (estimated) required for completion of existing project		114,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$15,000.00	
For maintenance of improvement	10,000.00	
		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L 6.)

7. *Urbana Creek, Virginia.*—Urbana Creek enters Rappahannock River from the right bank at a point about 16 miles above its mouth. In 1874 a bar existed outside the mouth over which but 6½ feet depth could be carried at low tide. In 1882 a shoal within the creek, having a least depth of 7 feet, and near the town of Urbana, was regarded as obstructing steamboat navigation.

The project for improvement adopted in 1879 comprised excavation of a channel 150 feet wide and 10 feet deep through the outer bar; estimated cost, $20,000. This project was modified in 1883 to include dredging through the inner bar and in 1888 to include jetties at the mouth to maintain the channel. The revised estimated cost was $34,580.

On account of the exposed position of the channel through the outer bar the work suffered from the action of northwesterly winds, which caused shoaling in the channel and a diminution in its width. In April, 1897, a survey was made to determine the extent of change in the channels and an estimate rendered in June following of the cost of completing the project by dredging and construction of a jetty to protect the channel dredged through the outer bar. This cost, added to the amounts expended to date, increases the estimated cost of the present project to $70,000.

The appropriations for this work from March 3, 1879, to March 3, 1899, aggregated $33,500. The amount expended to June 30, 1899, was $29,963.87. It resulted in securing a channel 10 feet deep and 150 feet wide through the outer bar. The shoal within the creek was several years ago dredged to some extent, but during the suspension of operations it had partially re-formed and required redredging, the ruling depth being 8½ feet.

During the past fiscal year a channel 10 feet deep and 135 feet wide has been dredged through the bar inside the creek and a small turning basin provided at the steamboat wharf.

The maximum depth on June 30, 1900, was about 9.7 feet at mean low water.

The improvement has been of benefit to commerce and navigation by permitting the entrance of sailing vessels to the creek and enabling one of the steamers of the Weems Line, Baltimore to Fredericksburg, to enter the creek and land at the wharf.

The value of the commerce and navigation of the stream is indicated by the following table of commercial statistics; the principal articles of commerce are oysters, tobacco, railroad ties, coal, grain, and lumber.

Commercial statistics.

Calendar year—	Reported by Mr. F. A. Bristow.	Reported by Mr. J. D. Gresitt.
	Tons.	*Tons.*
1891	19,500	22,100
1892	20,095	17,125
1893	55,585	61,290
1894	82,895	88.305
1895	66.530	92,320
1896	137,485	183.925
1897	163.875	181,600

Commercial statistics received for 1898 and 1899 are not in a form to be used.

The sum of $9,000 is asked for the fiscal year ending June 30, 1902, to be expended in dredging and maintenance of the channel by jetty work.

July 1, 1899, balance unexpended	$3,534.13
June 30, 1900, amount expended during fiscal year	2,564.81
July 1, 1900, balance unexpended	969.32
July 1, 1900, amount covered by uncompleted contracts	189.62
July 1, 1900, balance available	779.70
Amount (estimated) required for completion of existing project	36,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	9,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 7.)

8. *Harbor at Milford Haven, Va.*—Milford Haven is a tidal estuary of Chesapeake Bay, situated on its western shore, near Cherry Point, at the mouth of Piankatank River, and about 35 miles north of Old Point Comfort. The haven is about 4 miles long and from one-half mile to 1 mile wide. Its general direction is northwest and southeast. The depth in the channel ranges from 6½ to 15 feet, but is generally 7 feet or more. The haven has two entrances, one at the northwest end, at Hills Bay, an arm of the Piankatank River, about 2 miles from Cherry Point, and another at the southeast end, on Chesapeake Bay, about 5 miles below Cherry Point, thus separating from the main shore a considerable body of land known as Gwynns Island. Both entrances are obstructed by bars. The southeast entrance is exposed, and as the bar has a ruling depth of but 5 feet is but seldom used. The northwest entrance from Piankatank River is the one generally used by vessels and steamers entering the haven, and before improvement the bar obstructing this entrance had a ruling depth of 8 feet.

The original—which is also the present—project for improvement was adopted by act of Congress of March 3, 1899, and proposed the dredging of a channel 10 feet deep, with a minimum width of 200 feet, through this bar at an estimated cost of $12,500.

By act of Congress approved June 6, 1900, it was provided that "The unexpended balance of the appropriation for the improvement of the harbor at Milford Haven, Virginia, or any part thereof, may, in the discretion of the Secretary of War, be used for the improvement of the bar within said harbor." This inner bar has a ruling depth of about 8 feet, but it was not included by the act of March 3, 1899, in the original survey or project, which provided only for the bar at the "entrance."

The amount expended up to the close of the fiscal year ending June 30, 1899, was $8. No work of improvement had then been done, but an examination of the outer bar made in June, 1899, showed that the general configuration of the bar had remained the same, while the shoal point had built out more into the channel, and the ruling depth had increased to 9.8 feet.

Proposals for dredging the outer bar were opened August 26, 1899, and a contract was made with A. M. Clegg & Co., of Washington, D. C. The contractors having failed to commence work at the time specified, the contract was annulled December 23, 1899. The work was readvertised and a contract made with the Norfolk Dredging Company.

Work under this contract was begun April 24, 1900, and was in progress at the close of the fiscal year, at which time 9,825.7 cubic yards had been removed, affording a channel 10 feet deep at low water, with a minimum width of about 50 feet entirely through the outer bar.

The balance of the appropriation remaining, when the dredging of the outer bar has been completed, will be applied to work upon the inner bar. About $5,000 additional will be required to complete the latter channel.

The present ruling depth on the outer bar is 10 feet. On the inner bar it is 8 feet, which is the maximum draft that can be carried at low water over the shoalest part of the channel.

Commercial statistics for this improvement could not be procured.

July 1, 1899, balance unexpended		$12,492.00
June 30, 1900, amount expended during fiscal year		1,510.21
July 1, 1900, balance unexpended		10,981.79
July 1, 1900, outstanding liabilities	$161.00	
July 1, 1900, amount covered by uncompleted contracts	7,804.00	
		7,965.00
July 1, 1900, balance available		3,016.79
Amount (estimated) required for completion of existing project		5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix L 8.)

9. *York River, Virginia.*—York River is 41 miles long and discharges into Chesapeake Bay about 16 miles above Old Point. Entering the river, 24 feet can be carried for 32 miles, or up to Potopotank Bar, 9 miles below Westpoint. In 1880 the ruling depth on this bar was 18.5 feet. Westpoint Bar, the next obstruction to navigation, commences about 2 miles below and extends up to Westpoint. Before improvement it had a ruling depth of 15.5 feet.

The original project for improvement, adopted in 1880, proposed dredging channels 22 feet deep and 200 feet wide through the bars. In 1884, on account of growth of trade, the width was increased to 400 feet, and in 1887 the project was further amended to include construction of a dike along the right bank at Westpoint Bar to maintain the channel. Total cost of the revised, which is the present, project, $308,800.

Total amount expended to June 30, 1899, $223,978.70. The work done resulted in a dredged channel 105 feet wide and 22 feet deep at Potopotank, and one 22 feet deep and 160 to 260 feet in width at Westpoint Bar. This latter channel narrowed and shoaled, and had to be redredged. A training dike 10,142 feet long was constructed at Westpoint Bar, at which point the last dredging was done in 1895. An examination made in April, 1897, of the work at this bar showed that the part of the channel dredged in 1895 was in serviceable condition, it being 22 feet or more in depth and 150 to 200 feet wide, the dike evidently having the desired effect. Examinations of the channel made in June, 1898, and May, 1900, also showed continued favorable action of the dike.

A large and important commerce has been benefited by this improvement. Westpoint was for years the cotton-shipping point for the Southern Railway Company, and in 1894 there were shipped at this port 72,235 tons of cotton and 206,706 tons of general merchandise. The total of shipments for that year, as reported, was 379,808 tons. Seven hundred and fifty-eight arrivals and clearances of steamers drawing over 10 feet were reported for that year.

The following table shows the tonnage of the river from 1888 to 1894:

Reported for—	Tons.
1888	285,480
1889	328,353
1890	418,190
1891	304,338
1892	345,559
1893	351,390
1894	379,808

The Southern Railway Company in 1896 established a new terminal and shipping point at Norfolk, Va., and freight carrying on the river is reported as having fallen off considerably in consequence of the transfer.

Efforts have been made to procure commercial statistics for years subsequent to 1894, but without success.

In view of the falling off in extent of commerce, the views of those regarded as most directly interested in the navigation of the river were sought as to the present needs, in the way of width and depth of channels, of vessels navigating the river. The weight of opinion appeared to be that the improvement should proceed, notwithstanding the transfer of the said terminal and shipping facilities. Attention is invited to the correspondence in this connection attached to Appendix J 8 of the Annual Report of the Chief of Engineers for 1897.

On account of the existing conditions, the officer in charge suggested the maintenance of the channels already dredged, so that, whenever required, work under the full project might be resumed.

During the past year no field work was done excepting the placing of a few fascines and mattresses by hired labor at the lower end of the dike at Westpoint Bar to prevent erosion. An examination of the channel was also made.

The maximum draft in the shoalest part of the channel from the sea (Chesapeake Bay) to Westpoint which could be carried June 30, 1900, was 20 feet at mean low water at Westpoint Bar.

While the amount of river commerce is still below what it was prior to 1896, the establishment of new industries at Westpoint is producing an increase in the river business. The appropriation available will therefore be applied during the coming fiscal year in widening the channel at Westpoint Bar and in strengthening the dike. The sum of $10,000 is estimated for the fiscal year ending June 30, 1902, to be applied to dredging and maintenance of dike and channel.

July 1, 1899, balance unexpended	$15,771.30
June 30, 1900, amount expended during fiscal year	4,194.53
July 1, 1900, balance unexpended	11,576.77
July 1, 1900, outstanding liabilities	20.00
July 1, 1900, balance available	11,556.77
Amount (estimated) required for completion of existing project	69,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 9.)

10. Mattaponi River, Virginia.—The Mattaponi is navigable for small steamers and vessels from its mouth to Aylett, about 39 miles, and can be made navigable for small barges from Aylett to Monday Bridge, 16 miles. The obstructions to a 5½-foot navigation below Aylett consist of seven bars, upon which the ruling depths at low tide vary from 2.4 to 3.8 feet. Above Aylett there are numerous bars, but no work on them has been proposed. The river was also obstructed by snags, wrecks, and overhanging trees.

The original project for improvement, adopted in 1880, provided for removal of snags, wrecks, and leaning trees below Monday Bridge and the improvement of the bars below Aylett, so as to give a depth of 5½ feet at low tide and a channel width of 40 feet. This project was extended by the terms of the river and harbor act of July 13, 1892, which provided for the removal of snags as far up as Guineas Bridge, near Milford Station, on the Richmond, Fredericksburg and Potomac Railroad. Estimated cost of project, $72,100.

From June 14, 1880, to June 3, 1896, both dates inclusive, appropriations aggregating $29,800 were made for this improvement. Of this amount there was expended to June 30, 1899, the sum of $24,883.94, which resulted in the removal of snags, logs, and overhanging trees from the river between Robinson Bar and Monday Bridge and in keeping the river below Aylett free from such obstructions, and also in the construction of 2,297 linear feet of dike at Robinson Bar.

Proposals for dredging were twice invited in 1897. Only one bid was received, which was rejected as too high in price. Further action was then deferred until conditions should be more favorable.

The work already done upon this river has been of benefit to the existing commerce, the amount of which is shown by the following table. As snags and other obstructions form in greater or less degree after every freshet, much of the work done has had to be gone over again. Before any work for improvement was undertaken the trade was limited.

Tonnage, by years.

	Tons.		Tons.
1890	32,650	1893[1]	36,420
1891[1]	52,060	1894[1]	39,300
1892[1]	32,690		

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[1] Furnished by Mr. E. T. Lamb, Westpoint, Va.

Commercial statistics for the years 1895–1898 could not be procured. The total tonnage of the river for 1899 is stated as about 44,700 tons.

There is now one steamer plying between Westpoint and Walkerton (29 miles). Above this point a lighter-draft steamer runs to Aylett, 38.8 miles above Westpoint. Below Walkerton numerous vessels load with wood, lumber, etc., for coast ports.

The maximum draft that could be carried at mean low water over the shoalest part of the channel June 30, 1900, was 2.5 feet, at Walker Bar.

The sum of $3,000, estimated for the fiscal year ending June 30, 1902, is to be applied to continuance of work under the existing project.

During the fiscal year ending June 30, 1900, snags, logs, and similar obstructions were again removed from Westpoint to Dunkirk, a distance of 42 miles. The river is now practically clear of such obstructions from its mouth to Dunkirk.

July 1, 1899, balance unexpended	$4,916.06
June 30, 1900, amount expended during fiscal year	794.74
July 1, 1900, balance unexpended	4,121.32
Amount (estimated) required for completion of existing project	42,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 10.)

11. Pamunkey River, Virginia.—The Pamunkey River is navigable from its mouth, at Westpoint, on York River, to Hanovertown, a distance of about 59 miles. Seven feet of depth at low water can be carried to Buckland Bar, 38½ miles above Westpoint. Above this bar are six bars, extending along the river for about 15¼ miles, the ruling depths on which vary from 5½ to 1½ feet, excepting on the Upper or Indian Table Bar, which is exposed at low tide. Besides these bars are logs, snags, and overhanging trees.

The project for improvement, adopted in 1880 and amended in 1885, contemplated 7-foot navigation to Bassett Ferry, 47 miles from Westpoint; thence 5 feet to Wormley Landing, 54 miles; thence 3 feet to Hanovertown, the 7-foot channel to have a width of 100 feet and the other channels 40 feet. The wrecks, snags, logs, and trees obstructing navigation between Garlick Ferry and Hanovertown were also to be removed. The cost of this amended project, which is the present project, was estimated at $32,500.

The total expenditure to June 30, 1899, was $21,852.01. It resulted in removing several times snags and similar obstructions from about 30 miles of river, in removing parts of seven wrecks, and in partly improving Spring and Skidmore bars, 43 and 47 miles, respectively, from Westpoint.

Proposals for dredging were twice invited in 1897. Only one bid was received, which was rejected as too high, and further action was deferred until conditions should be more favorable.

During the fiscal year ending June 30, 1900, snags, logs, and similar obstructions were again removed from White House to 1 mile above Wormley Landing, a distance of 28 miles. The river is now practically clear of such obstructions from its mouth to within 2 miles of Hanovertown.

The maximum drafts that could be carried at mean low water over the shoalest part of the channels June 30, 1900, were as follows: In the 7-foot channel, 5.3 feet; in the 5-foot channel, 3.5 feet, and in the 3-foot channel, 2.2 feet.

The commerce of this river amounted, according to reports received, to 50,420 tons in 1893, and 42,250 tons in 1894, the greater part of the latter being railroad ties and wood. There is scarcely any trade on the 5 miles immediately below Hanovertown. Commercial statistics for the years 1895 to 1898 could not be obtained. The total tonnage of the river for 1899 is stated as about 44,600 tons.

The work remaining to be done to complete the existing project consists in dredging, construction of dikes, and removal of snags and logs. The sum of $3,000, estimated for the fiscal year ending June 30, 1902, is to be applied to that work.

July 1, 1899, balance unexpended	$3,647.99
June 30, 1900, amount expended during fiscal year	766.42
July 1, 1900, balance unexpended	2,881.57

Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 11.)

12. James River, Virginia.—Prior to 1870 a small sum had been expended with some advantage to navigation, but the improvement was not regularly undertaken by the United States until that year. The obstructions to navigation existing in 1870 consisted of artificial as well as natural ones. The artificial obstructions had been placed in the river during the war of 1861–1865 to prevent the national fleets from reaching Richmond. These consisted of sunken vessels and other impediments. There were also remains of military bridges.

The depths at mean low water in 1870, before operations commenced, were as follows:

Locality.	Distances.	Depths.
	Miles.	*Feet.*
Richmond to Goode Rocks	2	8
Goode Rocks	.25	7
Richmond Bar	.75	7
Richmond Bar to Drewry Bluff	3.75	9
Drewry Bluff to Curles	14	[a] 7
Curles to Hampton Roads	80	14.8

[a] In bend at Dutch Gap, now avoided by Dutch Gap Cut-off.

The original project was to give 18 feet depth at full tide to Richmond, with a channel width of 180 feet from Harrisons Bar to the city docks, the excavation in rock to be 18½ feet. The average rise of tide is 2½ feet. Work on this project was well advanced when Congress, July 5, 1884, adopted another of 22 feet at mean low tide from Richmond to the sea. The width to be given the channel is 400 feet from the sea to City Point, 300 feet from there to Drewry Bluff, and thence

200 feet to Richmond, estimated to cost $4,500,000. A large part of the excavation has been and will be in solid rock, and the cost is necessarily great. Operations consist in dredging, rock excavation, and the contraction and regulation of the waterway by means of dikes and jetties.

Work has been generally done first on the shoalest places in the river, with a view to obtaining the greatest benefit to commerce in the shortest time.

The amount expended on the improvement, to include June 30, 1899, was $1,769,352.69. It resulted in a channel 18 feet deep at mean low tide, and generally 75 to 100 feet in width from Hampton Roads to within 775 feet of the Richmond city line, excepting at Warwick Bar, 4½ miles below Richmond, where the depth was slightly under 18 feet, also at Goode Rocks, where, on account of isolated rocks recently discovered by the United States engineers while examining the channel, the depth is reduced to 16½ feet, and in Stearns Dike section, where, on account of a single unbuoyed rock, also discovered in the recent examination, the depth was 14½ feet.

For 170 feet below the city line a least depth of 14½ feet could be carried over a narrow channel.

A saving of about 5½ miles of difficult river was effected several years ago by opening Dutch Gap Cut-off.

The work of improvement during the fiscal year ending June 30, 1900, carried on under the appropriation of $150,000 by act of Congress approved March 3, 1899, has consisted in continuance of removal of obstructions, largely rock, from the channel between Richmond and Drewry Bluff by extending the excavation of rock up to the Richmond city line, enlarging the channel at Goode Rocks and the upper part of Richmond Bar to a width of 150 feet and a least depth of 18 feet at mean low tide, and in constructing and maintaining jetties and dikes.

There is now a practicable channel from Hampton Roads to Richmond with a ruling depth of 16½ feet and general width of 90 to 100 feet to the point in Stearns Dike section between jetties 23 and 25, about 1¼ miles below Richmond, where the unbuoyed rock above mentioned lies. The maximum depth at mean low tide over this rock was 14½ feet at the close of the fiscal year. Vessels drawing 16½ feet can pass on either side of this rock. The rock will be removed and the channel given its full depth.

Other isolated rocks were discovered, the removal of which will receive prompt attention.

The work of improvement will be continued during the fiscal year ending June 30, 1901, under the contract made October 2, 1899.

The value to commerce of an improvement of this river is shown by the following table of river tonnage between 1890 and 1899:

	Tons.		Tons.
1890	743,122	1896	680,935
1891	739,308	1897	661,909
1892	616,755	1898	472,778
1894	616,269	1899	571,802
1895	602,582		

The amount estimated for the fiscal year ending June 30, 1902, is for widening and deepening the channel below Richmond, mostly by rock excavation, and for widening and deepening channels by dredging, principally at Warwicks and Harrisons bars, Dancing Point Shoals, Swans Point, and Goose Hill Flats.

July 1, 1899, balance unexpended		$153,147.31
June 30, 1900, amount expended during fiscal year		42,753.59
July 1, 1900, balance unexpended		110,393.72
July 1, 1900, outstanding liabilities	$1,177.00	
July 1, 1900, amount covered by uncompleted contracts	55,026.00	
		56,203.00
July 1, 1900, balance available		54,190.72
Amount (estimated) required for completion of existing project		3,317,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		390,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix L 12.)

13. *Protection of Jamestown Island, Virginia.*—The river and harbor act of 1894 contained an item of $10,000 for protection of Jamestown Island. The shore had been wearing away for years from action of waves, and the erosion had reached a point where protection was required if the old landmark was to be preserved. The appropriation was applied to construction of a wall faced with granite laid without mortar in front of the threatened portion of the island, to grading and turfing the bank behind the wall, and to construction of several groins in front of it. This work was completed in 1895.

The soil of the island is light and easily moved. The funds did not admit of covering the part requiring protection with the kind of work desirable. Storms, especially those of the winter of 1895 and 1896, greatly damaged the work.

The river and harbor act of June 3, 1896, appropriated $15,000 for this protection.

Examination of the eroded front was made during the winter of 1896 and 1897, and a plan for the application of the appropriation of 1896 was decided upon. No work of construction, however, could be undertaken until satisfactory arrangements should be made whereby working parties could go upon certain land the protection of the front of which would have constituted the principal part of the work. Full understanding in that respect was not finally arrived at until the 10th of June, 1899, at which time the remaining permit needed to enable the United States engineer to enter upon the ground was received. In the fall of 1899 an additional examination, including needed borings, was made at the site for the work—the results of which were plotted last winter—with the result of revising the plan of 1897 in accordance with conditions observed in 1899. The plan as revised consists of a revetment of closely laid large flagstones or concrete blocks, with a backing of macadam one foot thick placed against the island bank, the grade of which is to be about 1 on 2½, or, where the bank is at a low elevation, against embankments whose outer and inner slopes are 1 on 2½ and 1 on 1¾, respectively, the outer toe of the embankments and the revetment to be buttressed by a line of piles cut off at low water and united by a stringpiece to which driven sheet piling is to be spiked, the pile buttress to be protected by stone riprap if found necessary.

It is expected to commence the protection work under the appropriation of June 3. 1896, early in the coming fiscal year.

The amount expended on this work up to June 30, 1899, was $9,274.45.

July 1, 1899, balance unexpended	$15,725.55
June 30, 1900, amount expended during fiscal year	678.57
July 1, 1900, balance unexpended	15,046.98

(See Appendix L 13.)

14. Removing sunken vessels or craft obstructing or endangering navigation.—(*a*) *Barge John Hagan, in harbor of Richmond, Va.* This wreck having been reported as injurious to navigation, an examination of the same was made in June, 1899, and Lieutenant-Colonel Allen was charged with its removal; but the wreck was broken up and all parts obstructing navigation removed by the authorities of the city of Richmond, Va., without expense to the United States. The work was completed by September 15, 1899.

(*b*) *Sloop Thomas H. Ruark, on Mattawoman Shoal, Potomac River.*—This wreck was broken up by blasting on October 12, 1899, and a clear depth of about 26 feet left over the débris. The work was done by hired labor and use of the steam launch *Neva*, belonging to the United States. The cost of the work was $81.67.

(See Appendix L 14.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBER ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harber act of March 3, 1899, were made by the local engineer, Lieut. Col. Chas. J. Allen, Corps of Engineers, and reports theron submitted:

1. Preliminary examination and survey of Patuxent River, Maryland, at Bristol Bar.—Lieutenant-Colonel Allen submitted reports dated June 10 and November 29, 1899, respectively. He presents two plans for improvement, estimated to cost $10,500 and $6,840, respectively, the former being preferred. The reports were transmitted to Congress and printed in House Doc. No. 170, Fifty-sixth Congress, first session. (See also Appendix L 15.)

2. Preliminary examination and survey of Breton Bay, Maryland.—Lieutenant-Colonel Allen submitted reports dated June 10 and December 9, 1899, respectively, with plan for improvement at an estimated cost of $36,480. The reports were transmitted to Congress and printed in House Doc. No. 209, Fifty-sixth Congress, first session. (See also Appendix L 16.)

3. Preliminary examination and survey of Carters Creek, Virginia.—Lieutenant-Colonel Allen submitted reports dated June 10 and December 4, 1899, respectively. Two plans for improvement are presented, estimated to cost $33,900 and $25,600, respectively, the former being preferred. An estimate for dredging in the Eastern Branch, near Gallyhook Point, at a cost of $1,700 or $1,800, is also submitted. The reports were transmitted to Congress and printed in House Doc. No. 185, Fifty-sixth Congress, first session. (See also Appendix L 17.)

4. Preliminary examination of Jacksons Creek, in Middlesex County, Va., with a view to removal of bar at mouth.—Lieutenant-Colonel Allen submitted report dated June 10, 1899. It is his opinion, in which I concur, that the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 98, Fixty-sixth Congress, first session. (See also Appendix L 18.)

5. *Preliminary examination and survey of James River at Richmond, Va., with a view of ascertaining what expenditure will be necessary to continue the improvement to the head of navigation.*—Lieutenant-Colonel Allen submitted reports dated June 10 and December 9, 1899, respectively. The plan of improvement presented is estimated to cost $724,943.15, in addition to which, Lieutenant-Colonel Allen states, the navigation interests would be facilitated if provision be made for a turning area in the harbor, at an estimated cost of $150,000 or $200,000, depending upon the location. The reports were transmitted to Congress and printed in House Doc. No. 234, Fifty-sixth Congress, first session. (See also Appendix L 19.)

EXAMINATION OF QUANTICO CREEK, VIRGINIA, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Quantico Creek, Virginia*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF NORFOLK HARBOR, VIRGINIA, AND ITS APPROACHES, AND OF RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

This district was in the charge of Maj. Thomas L. Casey, Corps of Engineers, to December 21, 1899, and of Maj. James B. Quinn, Corps of Engineers, since that date. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. *Harbor at Norfolk and its approaches, Virginia.*—Before the present project of improvement was begun, in 1877, the harbor of Norfolk was obstructed by shoals at the mouths of the Eastern and Southern branches, the shoal in the Eastern Branch being about one-third of a mile long, with a low-water depth of 15 to 16 feet, that in the Southern Branch being short and with a depth of 22 to 23 feet.

The approaches to the harbor were obstructed by shoals at Sewall Point, 3 miles long, having a low-water depth of 20 feet, and at the mouth of the Western Branch, 1 mile long, with a low-water depth of 19 feet. The depths of these shoals and the widths of the channels, particularly in the inner harbor, where encroached upon by the Portsmouth and Berkley flats, were insufficient for the requirements of the port.

The revised project of 1885 is as follows: (1) To dredge a channel not less than 500 feet wide and 25 feet deep at ordinary low water from the deep water in Hampton Roads to Norfolk and the United States navy-yard on the Southern Branch, and also to dredge a channel in the Eastern Branch not less than 22 feet deep at ordinary low water, with a width of 700 feet at its mouth, and of not less than 300 feet at the Norfolk and Western Railway Bridge; (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet from Fort Norfolk to the United States navy-yard, and not less than 22 feet from the mouth of the Eastern Branch to Campostella Bridge, and to build a bulkhead at Berkley Flats.

To the project of 1885 there was added in 1890 the dredging of an anchorage at the mouth of the Western Branch, with a depth of not less than 25 feet at ordinary low water.

The deficiency act of July 7, 1898, appropriated $360,000 for securing a channel 450 feet wide and 28 feet deep at mean low water from Hampton Roads to the navy-yard, near Norfolk. This work was completed in December, 1898, and while a part of improvement of Norfolk Harbor was carried on under title of improving Elizabeth River.

On pages 1355 to 1364 of the Annual Report of the Chief of Engineers for 1897 will be found all the correspondence in the matter of removing 400 feet of Hospital Point in this harbor, with an estimate of the cost of the proposed work. The land necessary is owned by the United States, and is under the control of the Navy Department. The cutting off of the portion of the point indicated is necessary for the accommodation of the traffic in its vicinity.

The navigable channels are in good condition. The balance estimated to complete the project should be provided for dredging the flats at the mouth of the Southern Branch of the Elizabeth River, on the Berkley side, to within 75 feet of the pier-head lines. This will complete the project of 1885, except the dredging proposed between the Norfolk and Western Railway and the Campostella bridges, on which section improvement is not now needed.

The expenditures during the fiscal year ending June 30, 1900, amounted to $62.50, for examinations of channels and posting maps to date.

From Hampton Roads to the navy-yard near Norfolk, Va., the channel is of sufficient depth at mean low water to accommodate vessels of 28 feet draft. In the Eastern Branch of the Elizabeth River vessels of 22 feet draft can navigate the river as far as the Norfolk and Western Railway Bridge.

The amount expended on this improvement to June 30, 1899, was $1,340,852.90; in addition, the sum of $197,500 was expended in dredging between Lambert Point and Fort Norfolk under separate project.

The commerce for the calendar year is reported at 6,260,284 tons, that for the calendar year 1898 having amounted to 6,510,201 tons.

July 1, 1899, balance unexpended	$3,663.52
June 30, 1900, amount expended during fiscal year	62.50
July 1, 1900, balance unexpended	3,601.02
Amount (estimated) required for completion of existing project	56,774.56
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	56,700.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 1.)

2. *Western Branch of Elizabeth River, Virginia.*—The channel of the river, when the project for the improvement was adopted in 1896, was 12 feet deep at mean low water and 50 to 300 feet wide.

The adopted project provided for obtaining by dredging a channel 200 feet wide and 20 feet deep at mean low water from deep water in Norfolk Harbor for a distance of about one mile, at an estimated cost of $45,000.

The sum of $44,418.73 had been expended on the improvement June 30, 1899, the result being the completion of the project.

The expenditures during the fiscal year ending June 30, 1900, amounted to $207.50 for making an examination of the river to determine the condition of the channel.

A draft of 20 feet could be carried in the channel on June 30, 1900. The commerce amounted to 346,835 tons in the calendar year 1898, and in 1899 to 576,898 tons.

July 1, 1899, balance unexpended	$581.27
June 30, 1900, amount expended during fiscal year	207.50
July 1, 1900, balance unexpended	373.77

(See Appendix M 2.)

3. *Nansemond River, Virginia.*—In 1872 this river was navigable at low water over the course covered by the present project, by boats drawing 5 feet. The channel way was, however, badly obstructed by wrecks and snags.

The sum of $37,000 was expended between 1873 and 1878 in securing a channel 8 feet deep at mean low water from the mouth of the river to Suffolk, Va.

The present adopted plan of improvement is to secure a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of the Western Branch, 5.37 miles, including a turning basin 200 feet square 300 feet below Suffolk Bridge, by dredging and by the construction of spurs and training walls; and a channel of like depth from the mouth of the Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end and gradually increasing to at least 400 feet at its lower end, etc., the total estimated cost being, in round numbers, $152,500.

On June 30, 1899, $40,095.37 had been expended under the present project, channels being dredged through shoals between Suffolk and the Western Branch about 5.37 miles below, giving a channel 80 feet wide and 12 feet deep at mean low water to the latter point. A turning basin 300 feet below the bridge at Suffolk has also been provided. The channels are in fair condition.

Operations during the fiscal year ending June 30, 1900, were confined to the removal of a tree which obstructed navigation about 4 miles below Suffolk, Va., and making an examination. The available funds are being reserved until the amount is sufficient to undertake work toward the completion of the project.

At the close of the fiscal year 1900 a boat drawing about 12 feet of water could go to Suffolk, the head of navigation, at mean low water.

The commerce as reported for the calendar year 1898 amounted to 31,796 tons. A statement of the commerce during the calendar year 1899 could not be obtained.

July 1, 1899, balance unexpended	$9,904.63
June 30, 1900, amount expended during fiscal year	31.67
July 1, 1900, balance unexpended	9,872.96
Amount (estimated) required for completion of existing project	102,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 3.)

4. Appomattox River, Virginia.—This river was navigable at high water for vessels drawing about 6½ feet, before its improvement, as far as Petersburg, 11 miles from the mouth, at Citypoint, Va. This channel was tortuous, and numerous shoals limited to that degree the draft that could safely be carried into the river.

The project for this improvement, adopted in 1870, provided for obtaining, by dredging shoals and the construction of contracting works, a channel 12 feet deep at mean high water, and of such width as was thought could be maintained by the tidal flow. The estimated cost of this work was $423,830, and in addition $10,000 annually for the maintenance of the channel and contracting works. It being desirable to extend the contracting works contemplated under the original project, the estimate was increased to $473,920 in 1893.

The amount expended on the improvement to June 30, 1899, was $431,587.96.

By 1875 a channel 60 feet wide and 12 feet deep at mean high water had been secured from Petersburg to Point of Rocks, by dredging such shoals as required it and by making a cut-off called "Puddledock Cut." This channel was subsequently increased to 80 feet in width, but is not stable, as the frequent freshets to which this stream is subject cause the formation of bars at several localities, which it is necessary to remove from time to time in order to keep the channel of the proper dimensions to permit its being used by the usual sized vessels calling at Petersburg to load or discharge cargo.

Dredging by hired plant and employment of day labor to wheel the material dredged ashore was in progress from the commencement of the fiscal year on this stream until October 30, 1899, and 22,900 cubic yards of material, scow measurement, was removed from shoals at the following localities:

In dredging over a width of 40 feet for a distance of 650 feet, through the shoal at Rushmores Dike, 7,200 cubic yards of clay, mud, and sand were removed. At the shoal in the vicinity of Sunken Island a channel 40 feet wide, 300 feet long, and 20 feet wide for an additional length of 1,000 feet was dredged, 12,550 cubic yards of mud and sand being removed. The dredging at Mills Bar resulted in a channel 40 feet wide for 100 feet and 20 feet wide for an additional 450 feet, the material removed being mostly sand, and amounting to 3,150 cubic yards. Besides this work, 5,000 cubic yards of material, dredged at the expense of the city of Petersburg, was wheeled ashore to reinforce the closure dike, the expense for labor also being borne by the city, the United States only paying for the services of a tugboat to tow the material and for a master laborer to supervise the work, which only cost, under these conditions, a total of $293.45. The cost of dredging was about 24 cents per cubic yard, placed on shore.

On June 30, 1900, vessels drawing 9 feet of water could navigate the river at mean high water as far as Petersburg, the head of navigation.

The commerce on the river for the calendar year 1899 was valued at $710,237. In 1898 statistics furnished show the commerce to have been valued at only $661,890.

July 1, 1899, balance unexpended	$7,242.04
June 30, 1900, amount expended during fiscal year	7,208.73
July 1, 1900, balance unexpended	33.31

Amount (estimated) required for completion of existing project	48,090.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement under existing project, in addition to the balance unexpended July 1, 1900	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix M 4.)

5. *Harbor at Cape Charles City, Va.*—This harbor is an artificial rectangular basin of about 10 acres area, originally excavated to a depth of 12 feet in a pond just back of the shore of Chesapeake Bay, about 12 miles north of Cape Charles. It is in Northampton County, and forms the shore terminus of the New York, Philadelphia and Norfolk Railroad Company, transfer of passengers and freight being made by boat to and from Norfolk, Va. The tide rises on an average about 2.6 feet.

The adopted project provides for dredging the harbor to a depth of 14 feet and the entrance thereto and the channels in Cherrystone Inlet and across Cherrystone Bar to a depth of 16 feet at mean low water, the width at the inlet and bar to be 100 and 200 feet, respectively, and protecting the channel entering the basin by two stone jetties, one on the north side and the other on the south side. The dredging was estimated to cost $45,400 and the jetties $84,000, with $12,940 for contingencies.

The expenditures for this improvement to June 30, 1899, amounted to $34,982.46, with the result that about one-half of the area of the harbor was given a depth of 14 feet at mean low water, the entrance deepened to 16 feet at the same stage of the tide, and the shoal in Cherrystone Inlet partly removed. The jetty on the north side of the entrance has been built from the shore outward for a distance of 1,200 feet, 750 feet of which was constructed without expense to the United States by the New York, Philadelphia and Norfolk Railroad Company. The entrance channel shoaled considerably since it was deepened and was redredged during 1897.

The expenditures in the fiscal year ending June 30, 1900, were for work on jetties performed under contract, advertising, and contingencies.

About 300 feet of the extension to the north jetty has been completed, and for an additional 125 feet stone has been placed to a height of about 4 feet above mean low water. When stone has been distributed over this latter distance the jetty will be completed, its total length being 1,625 feet. On the south jetty brush has been laid from shore out, a distance of 126 feet, and for the first 41 feet of that distance all stone required has been placed. For 50 feet of the length the stone has been placed to about 3 feet above mean low water, and at the outer 35 feet only stone enough has been placed to hold the brush foundation in place. It is thought that under the present contract about 500 feet of the south jetty from the shore out will be completed in addition to the 425 feet of the north jetty practically finished.

The channel is available at mean low water for vessels of 13 feet draft.

The commerce for the calendar year 1899 is reported to have amounted to 591,298 tons.

July 1, 1899, balance unexpended		$20,017.54
June 30, 1900, amount expended during fiscal year		10,420.35
July 1, 1900, balance unexpended		9,597.19
July 1, 1900, outstanding liabilities	$5,224.58	
July 1, 1900, amount covered by uncompleted contracts	3,824.96	
		9,049.54
July 1, 1900, balance available		547.65

Amount (estimated) required for completion of existing project	87,340.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 5.)

6. *Nandua Creek, Virginia.*—The channel entrance to this creek is narrow and sinuous, with a minimum depth of about 5 feet at mean low water. Within the creek the channel is ample for all commercial requirements.

The object of the project adopted May 11, 1899, is to provide a straight channel from Chesapeake Bay to connect with the one within the creek, by dredging a distance of about 1,200 feet over a width of 100 feet, to a depth of 8 feet at mean low water, across the spit at the entrance, which extends about 1 mile to the southward of the interior channel, at an estimated cost of $6,000. The present depth along the line of the proposed channel is little in excess of 2 feet at mean low water.

To June 30, 1899, the sum of $11.92 had been expended for inspection.

The expenditures during the past fiscal year were for dredging and contingencies.

Under a contract 10,950 cubic yards of sand, scow measurement, was removed, at the price of 27 cents per cubic yard. This removal resulted in a channel with a least width of 50 feet and 8 feet deep at mean low water for a distance of 1,000 feet. The work of dredging the projected channel was commenced on the interior of the creek and has been carried toward Chesapeake Bay the distance stated. A distance of 200 feet remains to be covered to carry it through to the bay with a least width of 50 feet.

When the new channel is finished a draft of 8 feet may be carried into the creek at mean low water, but owing to its exposed position it is not considered that the depth in the new channel will exist for any length of time. A vessel drawing about 5 feet can possibly enter the creek via the old channel at mean low water.

The commerce in the calendar year 1898 amounted to 8,550 tons, and that during the calendar year 1899 to 7,500 tons.

July 1, 1899, balance unexpended		$5,988.08
June 30, 1900, amount expended during fiscal year		2,324.60
July 1, 1900, balance unexpended		3,663.48
July 1, 1900, outstanding liabilities	$989.94	
July 1, 1900, amount covered by uncompleted contracts	2,592.43	
		3,582.37
July 1, 1900, balance available		81.11

(See Appendix M 6.)

7. *Waterway from Norfolk, Va., to the sounds of North Carolina.*—This route is composed of the following bodies of water:

Deep Creek, which enters the Southern Branch of the Elizabeth River 5½ miles above the Norfolk Navy-Yard; the Dismal Swamp Canal, which connects Deep Creek with the Pasquotank River, North Carolina; Turners Cut, and the Pasquotank River, which empties into Albemarle Sound, which connects with Pamlico Sound through Croatan Sound.

The Dismal Swamp Canal, which forms part of this route, is the property of a private company. Certain improvements carried out by the company were not available to the interests of navigation, owing to insufficient channel in waters connecting the canal with Elizabeth River at the north and Albemarle Sound on the south.

The river and harbor act of March 3, 1899, authorized a continuous contract for the work necessary to complete the improvement of the approaches to the canal. A contract was made August 1, 1899, for the improvement authorized.

This contract, which is based upon the existing project, provides for dredging in Deep Creek, Turners Cut, Pasquotank River, and Croatan Sound and bank protection in such localities as may require it.

During the past fiscal year a channel was dredged in Deep Creek 10 feet at mean low water for a distance of 10,400 feet from its mouth, with widths of 45, 60, and 90 feet over lengths of 8,700, 200, and 1,500 feet, respectively, 199,346 cubic yards of material, scow measurement, being removed.

In Turners Cut several shoal spots and the point on each side of the mouth were removed to a depth of 10 feet at mean low water, 48,843 cubic yards, place measurement, being removed.

In Pasquotank River work consists of removal of first point below the mouth of Turners Cut and the partial removal of the one opposite Sawyers Ferry. Eight thousand two hundred and seventeen cubic yards of material, place measurement, was removed.

The draft of vessels using this route is limited to about 9 feet, owing to the shoal at Shipyard Bar in the Pasquotank River, and in Deep Creek it is necessary for vessels of that draft to await high water before attempting to pass over the reach below and above the old dam, the narrow cut dredged by the canal company having filled up perceptibly.

Commerce valued at $285,884 passed through this route between September 1, 1899, the date on which the reconstructed Dismal Swamp Canal was opened to traffic, and December 31, 1899.

Under the prices of the continuous contract for making the improvements it was estimated that the whole work would cost about $246,620. The estimate of the quantity of material to be removed from Deep Creek will, however, probably be exceeded by about 50,000 cubic yards, so that it seems advisable to increase that estimate to $254,870, which still makes the cost come within the limit prescribed in the act of March 3, 1899.

It is thought that the contractor will make strenuous efforts to complete the balance of the work in the fiscal year 1901, and the amount given as required for the fiscal year 1902, in addition to the balance on hand June 30, 1900, will be needed to meet payments to become due on account of the following work: Removing 90,000 cubic yards of material from Turners Cut at contract price of 25 cents, $22,500; dredging 15,000 cubic yards of material in removal of shoal in Croatan Sound at contract price of 30 cents, $4,500, with $2,870 for inspection, contingencies, etc.

More detailed descriptions of this work have been given in previous reports.

July 1, 1899, balance unexpended		$25,000.00
Amount appropriated by sundry civil act approved June 6, 1900		200,000.00
		225,000.00
June 30, 1900, amount expended during fiscal year		22,281.07
July 1, 1900, balance unexpended		202,718.93
July 1, 1900, outstanding liabilities	$24,515.87	
July 1, 1900, amount covered by uncompleted contracts	183,991.19	
		208,507.06
Amount (estimated) required for completion of existing project		32,450.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		29,870.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix M 7.)

8. *Inland water route from Norfolk, Va., to Albemarle Sound, North Carolina, through Currituck Sound.*—This route is composed of the following bodies of water, viz: Elizabeth River, North Landing River, Currituck Sound, Coanjock Bay, North River, and the Albemarle and Chesapeake Canal. All are natural waterways with the exception of the canal, which is owned and controlled by a corporation. The canal proper has one lock, and extends from the head of the Southern Branch of the Elizabeth River to North Landing Bridge, a distance of 8.44 miles.

The original condition of the route permitted its navigation by boats drawing 5 feet of water. In some parts a draft of 7 feet could be carried. This channel was badly obstructed by overhanging growth, snags, sunken logs, and sharp bends in the rivers.

Prior to the river and harbor act of September 19, 1890, the improvement was carried on under projects for each part of the route, and to June 30, 1897, an aggregate of $240,169.69 had been expended on the separate works in an endeavor to secure a navigable channel, free from all obstructions, 80 feet wide and 9 feet deep. The channels at that time were from 25 to 80 feet wide and 8 to 9 feet deep.

The separate projects were primarily to obtain a 9-foot channel 80 feet wide throughout the entire route by dredging, removing obstructions, and constructing a dike in Coanjock Bay. When the consolidation was made the object of the separate projects was not altered, and the combined estimated cost of these projects remained the same. The latter was $306,667.08.

Since the consolidated project was adopted $38,987.66 had been expended thereunder to June 30, 1899, in widening the channels to the projected dimensions and in redredging shoals in the Southern Branch of the Elizabeth River and in removing sunken logs in the different parts of this route.

The expenditures during the fiscal year ending June 30, 1900, were for removing sunken logs and contingencies.

Proposals for dredging North River Bar, North Carolina, were opened June 11, 1900. The lowest offer received for the work was 70 cents per cubic yard, scow measurement; and this being considered excessive, all the bids were rejected.

Vessels drawing 8 feet of water could pass through this route on June 30, 1900. The commerce for the calendar year 1899 is reported to have amounted to 300,000 tons.

July 1, 1899, balance unexpended	$8,012.34
June 30, 1900, amount expended during fiscal year	1,177.36
July 1, 1900, balance unexpended	6,834.98
July 1, 1900, outstanding liabilities	80.00
July 1, 1900, balance available	6,754.98
Amount (estimated) required for completion of existing project	21,667.08
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	13,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix M 8.)

9. Edenton Bay, North Carolina.—Before any improvement was made the bay was obstructed by an extensive hard sand shoal, with a depth of 6½ feet. There is no tidal current in the bay and the variations in the water level are due to wind.

In 1878 and 1879 the Government, at an expense of $5,000, provided a channel 100 feet wide and 9 feet deep and partially dredged a projected turning basin.

The project of 1885 is to secure, by dredging, a channel 150 feet wide at the outer end and 200 feet wide at the inner end, with a triangular turning basin, midway, covering an area of 12 acres, the depth in the channel and turning basin to be 9 feet, and the length about 2,400 feet, or from the town wharf to deep water in Albemarle Sound. The estimated cost was stated to be $18,000.

When operations were suspended, in 1885, the sum of $9,552.59 had been expended in obtaining a channel over the entire length projected to the required depth, 150 feet wide at the outer end and 165 feet wide at the inner end, and in dredging 9½ acres of the turning basin. No operations were carried on since until the present fiscal year.

The expenditures during the fiscal year ending June 30, 1900, were for dredging, inspection, and contingencies.

Under a contract 10,005 cubic yards of material was removed at a cost of 21 cents per cubic yard. This dredging resulted in cutting back the point at the angle in the channel about 600 feet from the Norfolk and Southern Railroad a distance of 120 feet to a depth of 9 feet at mean low water.

A draft of 9 feet could be carried in the dredged channel of the bay on June 30, 1900.

The commerce for the calendar year 1899 amounted to 108,122 tons.

July 1, 1899, balance unexpended	$2,447.41
June 30, 1900, amount expended during fiscal year	2,260.73
July 1, 1900, balance unexpended	186.68
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 9.)

10. Roanoke River, North Carolina.—In 1872, before the improvement of this stream, a draft of 10 feet could be carried to Indian Highland Bar, 67 miles from the mouth, and 5 feet to Weldon, except during periods of low water, when it was limited to from 2 to 3 feet. In the part of the river below Indian Highland Bar wrecks and other obstructions placed during the civil war interfered with navigation, and the channel above was badly obstructed by snags, logs, stumps, and overhanging trees.

The project adopted provides for obtaining an unobstructed channel at all seasons of the year, 50 feet wide at its narrowest point, from Hamilton to Weldon, 5 feet deep at low water, and for removing obstructions from the channel below Hamilton to a depth suitable for vessels navigating the sounds of North Carolina. The estimated cost of the work contemplated under the project amounted to $269,000.

To June 30, 1899, $197,775.48 had been expended on the project, with the resultant of an unobstructed 10-foot channel as far as Hamilton, and a 5-foot channel at extreme low water from that point to Weldon, except in a few shoal places, where the depth was only 4 feet, and at a shoal a short distance below Weldon, where the depth is less than 4 feet.

Expenditures during the fiscal year ending June 30, 1900, were for office expenses, repairs to snag boat, and removing obstructions from the channel between Williamston and Weldon. An examination was also made of a shoal about 1 mile below Weldon.

The available depth of the channel on June 30, 1900, was 10 feet to Hamilton at extreme low water and 4 feet from that place to within a short distance of Weldon.

July 1, 1899, balance unexpended	$31,562.52
June 30, 1900, amount expended during fiscal year	6,184.56
July 1, 1900, balance unexpended	25,377.96

(See Appendix M 10.)

11. Removing sunken vessels or craft obstructing or endangering navigation—(*a*) *Wreck of ferryboat Manhasset.*—This vessel sunk in about 30 feet of water at low tide in the Southern Branch of the Elizabeth River, Virginia, just below the Norfolk Navy-Yard, and was removed under a contract during September, 1899, at a total expense of $1,406.08.

(*b*) *Wrecks of barge Caravan and schooner Augustus Palmer.*—These wrecks were in Lower Chesapeake Bay, the former in 28 feet of water on the Lower Middle Ground and the latter in 21 feet of water on the Tail of the Horseshoe. The total cost of their removal was $3,165.37, which work was completed early in December, 1899.

(*c*) *Wrecked cars.*—Two cars were knocked from a barge into Sewall Point Channel of the Elizabeth River, Virginia, just below Bush Bluff light-ship, in February, 1899. They were removed at a cost of $233.60 in the month of November of the same year.

(*d*) *Wreck of schooner R. L. Loper.*—This vessel was sunk in Hampton Creek, Virginia, near its mouth and on the western side of the channel. Its removal was effected at a cost of $100 on May 1, 1900.

(See Appendix M 11.)

EXAMINATION AND SURVEY OF MIDDLE GROUND BAR, HAMPTON ROADS, VIRGINIA, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of *Middle Ground Bar, in the harbor of Hampton Roads, Virginia, with a view to determining what amount of dredging is necessary over said bar to secure a channel 500 feet wide and 30 feet deep at mean low tide*, required by the river and harbor act of March 3, 1899, was made by the local engineer, Maj. Thomas L. Casey, Corps of Engineers, and reports thereon, dated July 14 and November 20, 1899, respectively, were submitted through the Division Engineer, Col. Peter C. Hains, Corps of Engineers. The plan presented for improvement is estimated to cost $225,000, and it is the opinion of the local officer, concurred in by the division engineer, that the General Government should undertake the improvement of this channel. The reports were transmitted to Congress and printed in House Doc. No. 93, Fifty-sixth Congress, first session. (See also Appendix M 12.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Norfolk, Va., to remove bar and secure depth of 28 feet at point between the 28-foot channel and the pier of the Southern Railway Company near Norfolk, Va.

2. Appomattox River, Virginia, resurvey and estimate for the deflection of the river at Petersburg.

3. Pagan River, from Smithfield, Va., to James River, with a view to securing a channel 80 feet wide and 10 feet deep at mean low tide, or such improvement as may be found expedient.

4. Chesconnessex Creek, an estuary of the Chesapeake Bay, running up into land on the western side of Accomac County, Va., with a view to dredging the same.

5. Pasquotank River, North Carolina, from South Mills to the 16-foot curve in Albemarle Sound.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN NORTH CAROLINA.

This district was in the charge of Capt. E. W. Van C. Lucas, Corps of Engineers, having under his immediate orders Lieut. Earl I. Brown, Corps of Engineers, to September 6, 1899. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. Ocracoke Inlet, North Carolina.—When the improvement by the United States began, in 1830, the governing low-water depths were 9 feet on outside (ocean) bar and 5 feet over inside (sound) shoals. Under project of 1827, to obtain 10 feet depth and 400 feet width at high water, the depth over inside shoal was increased 3½ feet, at a cost of

$133,732.40, but shoaling occurred, and the project was abandoned because of difficulty of maintenance with appliances then availabe.

In 1895 the governing low-water depths were 12 feet on outside bar and 7½ feet over inner shoals.

The project of 1889 was to dredge a channel 300 feet wide through the inner shoals, at estimated cost of $100,000 for 10 feet depth, $190,000 for 13 feet depth, and $280,000 for 15 feet depth, with necessary training walls and dikes, at an additional estimated cost of $320,000. This project was not attempted.

The project of May, 1894, was to dredge the Teachs Hole Swash Channel to 9 feet depth and 400 feet width, at an estimated cost of $29,339.38, and if channel shoaled so rapidly as to make its abandonment advisable, to dredge to 9 feet depth and 300 feet width at head of Blairs Channel, at an estimated cost of $28,000. This project was not attempted.

The project of July 9, 1894, was to dredge to 9 feet depth and 300 feet width through obstructions in Wallace Channel route at Beacon Island Slough, 700 feet long, and Royal Shoal, 5,000 feet long, at an estimated cost of $51,513.39. This project was carried out.

To June 30, 1899, $222,463.87 had been expended, $88,731.47 of which since 1890.

On June 30, 1899, the governing low-water depths were 7 feet at Beacon Island Slough and 8.2 feet at Royal Shoal Cut, and the channel was practicable at high water for 8 feet draft.

Work during the past year has been restricted to examinations and surveys. The governing low-water depths in May, 1900, for Wallace Channel route were 5 feet at Beacon Island Slough and 8.2 feet at Royal Shoal Cut, the channel being practicable at high water for 6.5 feet draft. The Teachs Hole Swash route, with governing low-water depth of about 6½ feet and high-water depth of 7 feet, is now the best.

The commerce for the six months ending December 31, 1899, amounted to 4,457 tons. Prior to July 1, 1899, no record of commerce had been kept for a number of years, though careful annual estimates were made prior to 1898, and the figures given above show a decrease (for year) of 32,407 tons from the average annual commerce, as estimated, for the years 1895 to 1897, inclusive. No transportation lines were established during the year.

The project was completed in 1896, and the dredged channels have since deteriorated. They can be redredged at an estimated cost of $40,000.

July 1, 1899, balance unexpended	$16,268.53
June 30, 1900, amount expended during fiscal year	567.00
July 1, 1900, balance unexpended	15,701.53
July 1, 1900, outstanding liabilities	55.00
July 1, 1900, balance available	15,646.53

(See Appendix N 1.)

2. *Fishing Creek, North Carolina.*—Distances: From mouth to Beach Swamp, 17½ miles; Coffield's bridge, 21.3 miles; Wilmington and Weldon Bridge, 40 miles; Bellamy's mill, 44 miles.

When improvement by the United States began, in 1896, the stream was badly obstructed by masses of fallen timber, and was navigable by rafts only for a few miles above the mouth.

The project of 1889 was to clear the stream of obstructions to Bellamy's mill, at an estimated cost of $25,000—amended in 1896 by limiting work to part below Wilmington and Weldon Railroad Bridge—at an estimated cost of $22,750, and to maintain natural channel.

To June 30, 1899, $14,771.40 had been expended.

On June 30, 1899, the stream had been cleared to Coffield's bridge, but was navigable by steamers to Beach Swamp only, above which point it is too crooked for steamers and has too swift a current for pole boats.

During the past year the stream has been thoroughly cleared to 24½ miles from mouth and from 31 milepost to Wilmington and Weldon Bridge, and partly cleared the remainder of the distance. It is now navigable during higher stages for steamers to Beach Swamp.

During the calendar year 1899 the commerce of the stream amounted to 4,002 tons, an increase of 460 tons over the preceding year. No transportation lines were established.

July 1, 1899, balance unexpended	$7,978.60
June 30, 1900, amount expended during fiscal year	6,079.79
July 1, 1900, balance unexpended	1,898.81
July 1, 1900, outstanding liabilities	442.53
July 1, 1900, balance available	1,456.28
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 2.)

3. *Pamlico and Tar rivers, North Carolina.*—(One river, called the Pamlico below and the Tar above Washington.) Distances: From Washington to Greenville, 22 miles; Tarboro, 49 miles; Fishing Creek, 56 miles; Little Falls, 88 miles; Rocky Mount, 89 miles.

When improvement by the United States began, in 1877, the river was obstructed by war blockades, rocks, and fallen timbers, the governing low-water depth being 5 feet to Washington and probably less than 1 foot to Tarboro. Navigation by river steamer was practicable during freshet stages to Tarboro.

The project of 1875 was to obtain a 9-foot channel to Washington; extended in 1879 to clear a 60-foot channel 3 feet deep to Greenville and 20 inches deep to Tarboro; extended in 1889 to clear natural channel to Little Falls; cost estimated in 1891 at $137,200.

To June 30, 1899, $103,108.68 had been expended.

On June 30, 1899, the governing low-water depths were 7½ feet to Washington, 3 feet to Greenville, and 20 inches to Tarboro, and the river was well cleared to mouth of Fishing Creek and obstructed to some extent beyond that point.

During the year the shoalest part of the channel below Washington was dredged to 9 feet depth and the channel snagged to Fishing Creek. The governing low-water depths are 8 feet to Washington and 2 feet to Greenville and about 15 inches to Tarboro.

During the calendar year 1899 the commerce of the stream amounted to 507,481 tons, a gain over the preceding year of 158.906¾ tons. No transportation lines were established.

July 1, 1899, balance unexpended	$14,891.32
June 30, 1900, amount expended during fiscal year	12,240.09
July 1, 1900, balance unexpended	2,651.23
July 1, 1900, outstanding liabilities	813.47
July 1, 1900, balance available	1,837.76
Amount (estimated) required for completion of existing project	29,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	32,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N 3.)

4. *Contentnia Creek, North Carolina.*—Distances: From mouth to Snow Hill, 31½ miles; Speights Bridge, 50¼ miles; Stantonsburg, 63 miles.

When improvement by the United States began, in 1881, the stream was choked with fallen timber, sand bars, and overhanging growth.

The project of 1881 was to clear of obstructions and obtain a depth of 3 feet to Stantonsburg during nine months annually at a cost, estimated in 1888, of $77,500; amended in 1894 to include maintenance below Snow Hill; amended in 1899 to include maintenance to Stantonsburg.

To June 30, 1899, $68,510.02 had been expended,

On June 30, 1899, the project depth existed to Snow Hill, but many obstructions had accumulated.

During the past year the stream has been snagged to Speights Bridge, to which point the project depth exists. Its condition is good to Snow Hill, excepting at 19 milepost, where a few trees felled by storm have not yet been removed because of low water. From Snow Hill to Speights Bridge the stream is navigable, but needs resnagging. Above Speights Bridge no clearing has been done since 1891, and there is no demand for any.

The commerce for the calendar year 1899 was 6,594 tons, an increase of 2,894 tons over preceding year. One transportation line was established during the year.

July 1, 1899, balance unexpended		$2,489.98
June 30, 1900, amount expended during fiscal year		1,577.76
July 1, 1900, balance unexpended		912.22
July 1, 1900, outstanding liabilities		.60
July 1, 1900, balance available		911.62
Amount (estimated) required for completion of existing project		8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$2,000.00	
For maintenance of improvement	2,500.00	
		4,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N 4.)

5. *Trent River, North Carolina.*—Distances from mouth, at Newbern, to Polloksville, 18 miles: to Lower Quaker Bridge, 27 miles; to Trenton, 38 miles.

When improvement by the United States began, in 1879, there was a depth of 6 feet to Polloksville, and the stream was fairly clear to Lower Quaker Bridge, above which point it was badly obstructed.

The project of 1879 was to obtain 3 feet depth, 50 feet wide, to Trenton; extended in 1886 to obtain 8 feet depth through Foys Flats, 6 miles above the mouth; cost estimated in 1887 at $59,000; extended in 1889 to include clearing natural channel 39½ miles above Trenton to Upper Quaker Bridge at additional cost of $13,000; extended in 1892 to include maintenance below Trenton.

The present project, of 1896, is to provide for maintenance, only, of channel 3 feet deep and 30 feet wide to Trenton.

To June 30, 1899, $65,369.04 had been expended.

On June 30, 1899, the river was somewhat obstructed and had shoaled to 2 feet just below Trenton, but the channel there was navigable at higher stages.

During the year the river has been snagged and is well cleared. The project depth and width exist excepting on two shoals at Trenton, aggregating 325 feet in length, on which the least depth is 2 feet.

The commerce for the calendar year 1899 amounted to 41,176 tons internal, and 95,841 foreign and coastwise, an increase over the preceding year of 7,563 tons internal, and decrease of 18,974 tons foreign and coastwise. Two transportation lines were established during the year.

July 1, 1899, balance unexpended	$3,630.96
June 30, 1900, amount expended during fiscal year	2,247.78
July 1, 1900, balance unexpended	1,383.18
July 1, 1900, outstanding liabilities	13.50
July 1, 1900, balance available	1,369.68
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 5.)

6. *Neuse River, North Carolina.*—Distances: From Newbern to Contentnia Creek, 32 miles; Kinston, 50 miles; Whitehall, 74 miles; Goldsboro (Wilmington and Weldon Railroad Bridge), 94 miles; Smithfield, 150 miles.

When improvement by the United States began, in 1878, the river was obstructed by war blockades and fallen timber, and the governing low-water depths were 8 feet to Newbern, 1½ feet to Kinston, and 1 foot to Smithfield.

The project of 1878 is to get 8 feet to Newbern and clear the river of obstructions to Goldsboro; extended in 1879 to obtain 4 feet low-water depth to Kinston by jettying and dredging; extended in 1880 to get 3 feet depth during nine months of the year to Smithfield.

To June 30, 1899, $295,640.86 had been expended.

On June 30, 1899, the river was considerably obstructed above Kinston, and the governing low-water depths were 8 feet to Newbern; 4 feet to Village Creek Shoals, 24¾ miles above; 2½ feet thence to Contentnia Creek, and 1½ feet thence to Kinston.

During the year work has been restricted to snagging, and the river is well cleared to Whitehall and fairly cleared to Goldsboro. The governing low-water depths are 8 feet (project) to Newbern, 4 feet (project) thence 24 miles farther, 2½ feet thence to Contentnia Creek, and 1.2 feet thence to Kinston.

During the calendar year 1899 the commerce of the stream amounted to 334,141 tons, a decrease of 8,674 tons from the preceding year.

July 1, 1899, balance unexpended	[1]$10,859.14
June 30, 1900, amount expended during fiscal year	7,297.03
July 1, 1900, balance unexpended	3,562.11
July 1, 1900, outstanding liabilities	351.46
July 1, 1900, balance available	3,210.65

Amount (estimated) required for completion of existing project	77,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 6.)

7. *Inland waterway between Newbern and Beaufort, N. C.* (via Neuse River, Clubfoot Creek, Clubfoot and Harlowe Canal (private), Harlowe Creek, and Newport River).—When improvement of the 9 miles of natural waterway and 3½ miles of private canal connecting Neuse and Newport rivers was begun by the United States in 1895, the governing low-water depth was 1 foot.

The project of 1884 is to obtain a channel 5 feet deep and 30 feet wide, at an estimated cost of $92,000.

To June 30, 1899, $28,214.39 had been expended.

On June 30, 1899, the dredged cuts had shoaled and 1½ feet was the governing low-water depth.

No work, except examinations, has been done this year. The channel is somewhat obstructed by snags and logs, and the limiting low-water depth is 1.5 feet over the shoal in Clubfoot Creek. Excepting snagging to maintain depth in approaches equal to that in canal, further work has been suspended to await cession or sale of the canal to the United States. (See Annual Report of the Chief of Engineers for 1891, p. 1364.)

The commerce for the calendar year 1899 amounted to 35,779 tons, an increase over the preceding year of 15,414 tons. One transportation line was established during the year.

July 1, 1899, balance unexpended	$6,785.61
June 30, 1900, amount expended during fiscal year	12.67
July 1, 1900, balance unexpended	6,772.94
July 1, 1900, outstanding liabilities	30.61
July 1, 1900, balance available	6,742.33

Amount (estimated) required for completion of existing project	57,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 7.)

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[1] Reported last year as $10,856.14; should have been $10,859.14. Expenditures last year should have been $53.98 instead of $56.98.

8. *Harbor at Beaufort, N. C.*—When improvement by the United States (begun in 1836) was resumed in 1881, the erosion at throat of inlet was causing serious deterioration of the inside channel and threatened deterioration of the bar channel. The governing low-water depths were 15 feet on the bar and 2 feet to Beaufort.

The project of January 29, 1881, was to stop the erosion at Shackleford Point by jetties and to dredge to 9 feet depth and 200 feet width from Bulkhead Channel to Beaufort, and to 6 feet depth and 100 feet width from Beaufort to North River; extended in 1884 to stop the erosion at Fort Macon by jetties and amended at same time to dredge channel 100 feet wide and 5 feet deep from Bulkhead Channel to Beaufort and omit dredging between Beaufort and North River; amended in 1890 by increasing to 7 feet the project depth from Bulkhead Channel to Beaufort. Project completed.

The project of 1896 is to maintain jetties and sand fences at Fort Macon and Shackleford Point.

To June 30, 1899, $152,148.14 had been expended.

On June 30, 1899, the governing low-water depths were 10 feet on the bar and 4½ feet to Beaufort.

Work during the past year has been restricted to maintenance of sand fences and jetties, and the governing low-water depths are 12 feet on the bar and 4½ feet to Beaufort.

During the calendar year 1899 the commerce amounted to 39,356 tons, a gain over the preceding year of 575 tons. No transportation lines were established.

July 1, 1899, balance unexpended	$2,851.86
June 30, 1900, amount expended during fiscal year	1,605.21
July 1, 1900, balance unexpended	1,246.65
July 1, 1900, outstanding liabilities	78.02
July 1, 1900, balance available	1,168.63
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 8.)

9. *Inland waterway between Beaufort Harbor and New River, North Carolina.*—Distances: From Beaufort to Swansboro, 30 miles; to New River, 52 miles, with access at Swansboro to the Atlantic Ocean through Bogue Inlet.

When improvement by the United States began in 1886, the governing low-water depth was 18 inches to Swansboro and 6 inches thence to New River.

The project of 1885 was to obtain a channel 3 feet deep and 100 feet wide from Beaufort to Swansboro; modified in 1896 by decreasing width to 60 feet. No project adopted for part between Swansboro and New River pending repeal of act of North Carolina legislature granting to private parties exclusive navigation privilege, which has now expired by limitation.

To June 30, 1899, $42,500 had been expended.

On June 30, 1899, the ruling low-water depth to Swansboro was 3 feet, with least width of 40 feet.

Work during the past year has been restricted to examinations, and the ruling low-water depth is 2 feet.

The commerce for the year 1899 amounted to 21,248 tons, a decrease since the preceding year of 720½ tons. No transportation lines were established during the year.

July 1, 1899, balance unexpended		$1,000.00
June 30, 1900, amount expended during fiscal year		24.33
July 1, 1900, balance unexpended		975.67
July 1, 1900, outstanding liabilities		20.01
July 1, 1900, balance available		955.66
Amount (estimated) required for completion of existing project		6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$6,500.00	
For maintenance of improvement	3,000.00	
		9,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix N 9.)

10. New River, North Carolina.—When improvement by the United States began, in 1886, the governing low-water depth was 4 feet, and the channel included two circuitous parts around Wrights Island and Cedar Bush Marsh.

The project of 1885 was to dredge channels 150 feet wide and 4 feet deep through Cedar Bush Marsh and Wrights Island; modified in 1892 to 100 feet width for Wrights Island Cut. Project completed.

The project of June 18, 1894, was to obtain 4 feet depth around Cedar Bush Marsh, by dredging and training wall, to replace channel dredged through marsh, which had shoaled. Project successfully completed in 1895, but has deteriorated through lack of maintenance.

To June 30, 1899, $29,600 had been expended.

On June 30, 1899, the project depth existed except around Cedar Bush Marsh, where governing low-water depth was 3 feet, through a narrow and crooked channel, with very little tidal rise.

During the year work has been limited to examinations, and the conditions remain about the same.

During the calendar year 1899 the commerce of the stream amounted to 4,610 tons, an increase of 2,503 tons over the year 1897 (no record for 1898). One transportation line was established during the year.

The project was completed in 1895. It has deteriorated since, and the cost of restitution is estimated at $7,500.

July 1, 1899, balance unexpended	$3,400.00
June 30, 1900, amount expended during fiscal year	9.13
July 1, 1900, balance unexpended	3,390.87
July 1, 1900, outstanding liabilities	19.61
July 1, 1900, balance available	3,371.26
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 10.)

11. Black River, North Carolina.—Distances: From mouth to Point Caswell, 24 miles; Haws Narrows, 34 miles; Clear Run, 64 miles; Lisbon, 86 miles.

When improvement by the United States was undertaken, in 1887, the river was cleared fairly to Point Caswell and roughly to Lisbon, the governing low-water depths being 4 feet to Point Caswell, 2½ feet to Haws Narrows, and 1½ feet to Lisbon.

The project of 1885 applied at least $10,000 to clearing obstructions and rounding sharp points to Lisbon; amended in 1893 by omitting river above Clear Run and limiting cost to $13,000; completed in 1895.

The present project (of 1894) is to maintain channel to Clear Run; amended in 1899 to include diking at Narrows.

To June 30, 1899, $15,546.53 had been expended.

On June 30, 1899, the river was navigable, but many obstructions had accumulated through lack of funds.

During the past year the river has been partly snagged to Clear Run; is navigable during stages of 1½ feet or more above low water about eight months annually. The present governing low-water depths are 5 feet to Point Caswell, 2½ feet to Haws Narrows, and 1½ feet to Clear Run.

During the calendar year 1899 the commerce of the stream amounted to 48,533 tons, an increase of 10,394 tons over preceding year. No transportation lines established during year.

July 1, 1899, balance unexpended	$2,696.81
June 30, 1900, amount expended during fiscal year	1,557.19
July 1, 1900, balance unexpended	1,139.62
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 11.)

12. Northeast (Cape Fear) River, North Carolina.—Distances: From mouth to Bannerman's bridge, 48 miles; Hallsville, 88 miles; Kornegay's bridge, 103 miles.

When improvement by the United States was begun, in 1890, the river was badly obstructed by logs, snags, and overhanging trees, and was navigable for small steamers to Bannerman's bridge, the governing low-water depth to that point being 6 feet.

The original approved project of 1889 is to clear the natural channel for small steamers to Hallsville and for pole boats to Kornegay's bridge, at an estimated cost of $30,000.

To June 30, 1899, $14,676.52 had been expended.

On June 30, 1899, no work had been done for two years, through lack of funds, and navigation above Bannerman's bridge was practically suspended.

During the past year the river has been made navigable and partly cleared to Hallsville, but navigation above Bannerman's bridge has not yet been resumed. The governing low-water depth is 6 feet to Bannerman's bridge, above which point navigation is practicable, even for pole boats, at freshet stages only.

The commerce for the calendar year 1899 amounted to 48,269 tons, a decrease from preceding year of 11,153 tons. No transportation lines were established during the year.

July 1, 1899, balance unexpended	$2,566.81
June 30, 1900, amount expended during fiscal year	1,510.68
July 1, 1900, balance unexpended	1,056.13

Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 12.)

13. Cape Fear River above Wilmington, N. C.—Distances: From Wilmington to Kellys Cove, 47 miles; Elizabethtown, 73 miles; Fayetteville, 115 miles.

When improvement by the United States was begun, in 1882, the governing low-water depths were 4 feet to Kellys Cove and 1 foot to Fayetteville, and the river above Kellys Cove was badly obstructed by snags, logs, and trees, but navigable at higher stages.

The original project of January 26, 1881, was to clear the river to Fayetteville and to obtain a continuous channel (depth not stated) by jettying and dredging; cost estimated in July, 1893, at $275,000 for a 4-foot depth to Elizabethtown and a 3-foot depth to Fayetteville.

To June 30, 1899, $136,762.81 had been expended.

On June 30, 1899, snagging had been resumed after over a year's suspension for lack of funds; the river contained many obstructions between Kellys Cove and Fayetteville.

During the past year the river has been three times snagged and the channel put in fair condition. The present governing low-water depths are 4 feet to Kellys Cove, 2½ feet to Elizabethtown, and 2 feet to Fayetteville.

During the calendar year 1899 the commerce amounted to 114,877 tons, a gain of 14,934 since the preceding year. No transportation lines were established.

July 1, 1899, balance unexpended	$5,901.52
June 30, 1900, amount expended during fiscal year	2,783.54
July 1, 1900, balance unexpended	3,117.98
July 1, 1900, outstanding liabilities	479.96
July 1, 1900, balance available	2,638.02

Amount (estimated) required for completion of existing project	132,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 13.)

14. Cape Fear River at and below Wilmington, N. C.—When improvement by the United States was begun on the river channels in 1829 and on the ocean bar in 1853 the governing low-water depths were 10 feet in the river channel, 7½ feet at the main bar entrance, and 8 feet at the New Inlet entrance.

The project of 1827 was to deepen the river channels in the 8 miles below Wilmington by jetty contraction. The project of 1853 was to deepen and straighten main bar channels by jetties and dams, by dredging, and by diverting water over main bar from New Inlet and vicinity.

The project of 1870 was to deepen the main bar channel by closing breaches between Smiths and Zekes islands; extended in 1873 to include closing New Inlet and dredging Bulkhead Channel; extended in 1874 to obtain, by dredging, 12 feet depth and 100 feet width to Wilmington; extended in 1881 to obtain 16 feet depth and 270 feet width to Wilmington.

The present project (of October 6, 1890) is to obtain a low-water depth of 20 feet and a width of 270 feet from Wilmington to the ocean.

To June 30, 1899, $2,836,516.37 had been expended.

On June 30, 1899, the least low-water depth between Wilmington and the ocean was 20 feet, excepting at Snows Marsh, where it was 18.7 feet, with a tidal range of 4¼ feet. The least width of 20-foot channel was 148 feet, excepting at Logs and Big Island, 37 feet, and Brunswick River Shoal, 74 feet.

During the year the 20-foot channel at Logs and Big Island Shoal has been increased in width to 111 feet; the shoal between wharves and east harbor line at Wilmington Shoal has been dredged to 22 feet; the bar channel has been deepened to 20 feet depth for least width of 300 feet, with a least depth in center of 21.7 feet.

The governing low-water depth is now 20 feet, excepting at Snows Marsh, where the depth is 18 feet, with a tidal range of 4½ feet.

The commerce during 1899 amounted to 621,852 tons, a decrease of 6,047 tons since the preceding year, but an increase in value from $31,538,150 in 1898 to $33,345,612. No transportation lines were established during the year.

July 1, 1899, balance unexpended		$188,226.59
June 30, 1900, amount expended during fiscal year		91,946.62
July 1, 1900, balance unexpended		96,279.97
July 1, 1900, outstanding liabilities	$4,094.03	
July 1, 1900, amount covered by uncompleted contracts	26,500.00	
		30,594.03
July 1, 1900, balance available		65,685.94

Amount (estimated) required for completion of existing project	885,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N 14.)

15. *Town Creek, Brunswick County, N. C.*—Distances: From mouth to Russells Landing (upper bridge), 20 miles; Rocks Landing, 23 miles.

When improvement by the United States was begun in 1883 the stream was badly obstructed by logs, snags, and trees, and by shoals just below Russells Landing, with 1½ feet low-water depth.

The original project of 1881 was to remove obstructions and dredge through shoals to 4 feet depth and 60 feet width. After spending $1,000 in channel clearing and dredging to 3½ feet depth and 28 feet width work was abandoned in 1883.

The project of 1899 is to remove obstructions to Rocks Landing and dredge channel 5 feet deep and 40 feet wide to Russells Landing.

To June 30, 1899, $1,000 had been expended under the project of 1881.

Work under the project of 1899 awaited, under the terms of the river and harbor act of March 3, 1899, the construction of a draw in the bridge at Russells Landing. Navigation was impeded throughout by fallen timber and by shoals at mouth and just below Russells Landing, the governing low-water depth being 3 feet.

During the past year the project depth and width have been obtained to Russells Landing, all obstructions removed to Three Creeks, near 21 milepost, and partly removed thence to Rocks Landing. The governing low-water depth to Russells Landing is 5 feet through 40 feet width. In upper 3 miles navigation is practicable only during freshet stages.

During the calendar year 1899 the commerce of the stream amounted to 61,859 tons, with an estimated value of $247,547.64. Prior to 1899 no record of commerce was kept.

July 1, 1899, balance unexpended	$8,500.00
June 30, 1900, amount expended during fiscal year	7,279.86
July 1, 1900, balance unexpended	1,220.14
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N 15.)

REPORT OF BOARD OF ENGINEERS ON EXAMINATION AND SURVEY FOR A HARBOR OF REFUGE AT OR NEAR CAPE LOOKOUT, NORTH CAROLINA, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey for a *harbor of refuge at or near Cape Lookout, North Carolina*, required by the river and harbor act of March 3, 1899, was made by a Board of Engineers, constituted in accordance with requirements of the act, and report thereon dated November 8, 1899, submitted. Interpreting the act to restrict the location of the harbor to a point "at or near Cape Lookout," the Board estimates the cost of the breakwater, including contingencies, at $3,526,600.

Under a liberal construction of the terms of the act in its reference to location the advantages of the vicinity of Cape Hatteras as a place for the proposed harbor have been considered by the Board and the relative merits of the two localities are briefly discussed in its report.

The report was transmitted to Congress and printed in House Doc. No. 80, Fifty-sixth Congress, first session. (See also Appendix N 16.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session.

1. Trent River, North Carolina, from the junction of Trent River with Neuse River up to Trenton, with a view to obtaining a depth of 8 feet at mean low water at the city of Newbern and up to the wharves and freight depots of said city, and a channel 50 feet wide and 8 feet deep from Newbern through Foys Flats to Polloksville, and a channel 30 feet wide and 4 feet deep at mean low water from Polloksville to Trenton.

2. Albemarle, Croatan, Pamlico, and Core sounds, North Carolina, to Beaufort Inlet, including also cost of procuring a navigable depth of 18 feet through Beaufort Inlet and through Ocracoke Inlet.

3. Wilmington Harbor, North Carolina, with a view to providing a sufficient width and depth to permit vessels now using said harbor to turn or swing around therein; Cape Fear River, with a view to obtaining a navigable channel from Wilmington to Fayetteville of 4, 6, or 8 feet at mean low water.

4. Scuppernong River, with the view of improving the bar at the mouth of Scuppernong River, emptying into Albemarle Sound, North Carolina, to the end that the channel be dredged 1,200 feet long, 150 feet wide, with 9 feet depth of water at mean low tide.

IMPROVEMENT OF WACCAMAW RIVER, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

This district was in the charge of Maj. E. H. Ruffner, Corps of Engineers, to January 1, 1900, and of Capt. J. C. Sanford, Corps of Engineers, since that date, the officer in charge having under his immediate orders Lieut. Edward H. Schulz, Corps of Engineers, to October 16, 1899. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. Waccamaw River, North Carolina and South Carolina.—In 1880 this stream was navigable for 12-foot boats at all stages of water from Georgetown, 23 miles, to Bull Creek, and at high water 4 miles farther, to Bucks Lower Mills; thence for 7-foot-draft boats, at high water, 22 miles farther, to Conway; thence it possessed an obstructed channel for 3-foot-draft boats, at ordinary winter water, 68 miles, to Reeves Ferry; thence an obstructed channel, with 3 feet at high water, for 30 miles, to Lake Waccamaw.

The project of improvement provides for a channel 12 feet deep at all stages of water, with 80 feet bottom width from the mouth of the river to Conway, thence a cleared channel to Lake Waccamaw, at an estimated cost of $138,400.

The original estimated cost was $29,370, which was revised in 1885 and increased in the annual report of that year to the present figure, $138,400. In the Annual Report of the Chief of Engineers for 1886, page 170, maintenance is estimated at $4,000 per year after completion of improvement.

The total expenditures to June 30, 1899, were $100,059.89. At that date the river was safely navigable for steamers over the whole improved portion, which extends 128 miles above the mouth.

During the past year the river was snagged between the mouth and a point 117 miles above, 1,883 obstructions being removed from the river and banks. This makes the aggregate number of obstructions removed since June 30, 1884, 35,150. Before June 30, 1884, the records are not sufficiently in detail to give exact figures. By the expenditures of the past fiscal year the lower 117 miles of the river has been kept clear of snags.

With existing balance it is proposed to continue snagging work. Under the estimate submitted in money statement below it is proposed to deepen and widen the channel by dredging to the dimensions contemplated by the approved project, working from the mouth up, and to keep the river clear of snags and other similar obstructions; also to make a survey of the river, to determine amount of work required to complete the existing project. As a considerable part of the money appropriated has necessarily been expended in maintenance, a revision of the estimate for completion will have to be made, based on results of the proposed survey.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1887	....	$2,129,231.75	1894	99,298	$2,120,864.00
1889	....	2,308,915.00	1895	128,466	2,063,697.00
1890	67,195	2,317,368.50	1896	203,388	2,314,175 00
1891	76,245	2,231,112.00	1897	241,300	2,406,390.00
1892	83,103	2,178,369.00	1898	258,191	2,666,280.00
1893	70,976	2,095,548.00	1899	376,822	3,135,214.00

July 1, 1899, balance unexpended	$2,840.11
June 30, 1900, amount expended during fiscal year	1,243.86
July 1, 1900, balance unexpended	1,596.25
July 1, 1900, outstanding liabilities	96.70
July 1, 1900, balance available	1,499.55
Amount (estimated) required for completion of existing project	35,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	9,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 1.)

2. *Little Pedee River, South Carolina.*—The river in its original condition was much obstructed by snags and overhanging trees and by ten bridges without draws. In places it was divided into several branches, in none of which was there a good channel.

Under the plan of improvement adopted in 1888 it is proposed to snag the river and close unnecessary branches, providing for steamboat navigation up to the mouth of Lumber River, 65 miles, and for pole-boat navigation 48 miles farther, to Little Rock, at an estimated cost of $50,000.

The total expenditures to June 30, 1899, were $21,749.99. No work has been done on the river since June 30, 1898. At that time the river had been well snagged up to the mouth of Lumber River and roughly cleared for pole-boat navigation to Little Rock. Some dredging will be needed to develop the full value of this stream.

With existing balance it is proposed to remove the worst obstructions that may appear. Under the estimate submitted in money statement below it is proposed to thoroughly snag the river from the mouth of Lumber River to Little Rock and to close unnecessary branches, as provided in the project, and to keep the river clear of snags below the mouth of Lumber River; also to make a survey of the river to determine the amount of work required to complete the existing project. As a considerable part of the money appropriated has necessarily been expended in maintenance, a revision of the amount required for completion will have to be made, based on the results of the proposed survey.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	4,614	$52,760	1896	17,050	$198,500
1892	7,115	92,964	1897	13,162	100,400
1893	6,153	101,535	1898	11,900	105,750
1894	8,375	114,600	1899	16,685	144,787
1895	12,438	117,470			

July 1, 1899, balance unexpended	$250.01
July 1, 1900, balance unexpended	250.01
July 1, 1900, outstanding liabilities	21.33
July 1, 1900, balance available	228.68
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 2.)

3. *Great Pedee River, South Carolina.*—The river in its original condition was dangerously obstructed by logs everywhere. Boats drawing 9 feet of water were able to reach Smith Mills, 52 miles above the mouth. Those drawing 3½ feet could get 54 miles farther up at low water to Little Bluff, or at high water to Cheraw, 172 miles from the mouth.

The project of improvement provides for a thoroughly cleared 9-foot navigation to Smith Mills and a 3½-foot navigation to Cheraw at all stages of water, at an estimated cost of $117,000.

The original project of 1880 contained no estimate of cost. From 1880 to 1886, inclusive, $47,000 was appropriated. In the Annual Report of the Chief of Engineers for 1886, page 170, it was estimated that $70,000, in addition to this $47,000, would complete the improvement, and that $5,000 a year would be required for maintenance.

The total expenditures to June 30, 1899, were $104,925.53. At that date the river had been kept fairly well cleared of snags below the Wilmington, Columbia and Augusta Railroad Bridge, 103 miles above the mouth, but the remaining 69 miles to Cheraw was still in bad condition.

During the year the river below the railroad bridge has been kept clear of snags, 2,514 obstructions being removed. Since June 30, 1884, 34,914 obstructions have been removed, the records before that date being incomplete. Some dredging will be needed to develop the full value of the stream.

With the existing balance it is proposed to make a preliminary examination, and survey if necessary, of that portion of the river between Cheraw and the Wilmington, Columbia and Augusta Railroad Bridge, as required by the emergency river and harbor act approved June 6, 1900, and to continue snagging work. Under the estimates submitted in money statement below, it is proposed to deepen and widen the channel in accordance with the approved project, working from the mouth up, and to keep the river clear of snags. As a considerable part of the money appropriated has necessarily been expended in maintenance, a revision of the estimate for completion will have to be made.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	62,344	$1,367,330	1896	229,964	$1,325,250
1892	92,471	1,401,038	1897	114,177	1,167,914
1893	94,661	1,166,874	1898	75,280	1,228,885
1894	91,025	1,169,070	1899	134,072	1,692,709
1895	106,115	898,430			

July 1, 1899, balance unexpended		$6,574.47
June 30, 1900, amount expended during fiscal year		3,590.84
July 1, 1900, balance unexpended		2,983.63
July 1, 1900, outstanding liabilities		175.50
July 1, 1900, balance available		2,808.13
Amount (estimated) required for completion of existing project		5,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$5,500.00	
For maintenance of improvement	5,000.00	
		10,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 3.)

4. *Georgetown Harbor, South Carolina.*—This harbor is that part of the Sampit River immediately within the bar at its mouth near the head of Winyah Bay.

In 1881 a bar 2,850 feet in length and with a controlling depth of 9 feet at ordinary low water existed at the mouth of the Sampit River.

The original project, adopted in that year, provided for dredging a channel across the bar 200 feet in width at bottom and 12 feet in depth at ordinary low water, at an estimated cost of $14,151.94. The material of the bar having been found much more difficult to dredge than had been expected, the estimate was several times revised, being finally fixed at $44,500. (Annual Report of the Chief of Engineers for 1889, p. 1103.)

The project for this work was practically completed in 1895 and the work was dropped from the list of improvements, the unexpended balance of the appropriation being turned into the Treasury to be held there to await further developments regarding necessity for its expenditure.

The channel having shoaled, authority was granted the local officer, in May, 1899, to apply the remaining balance to the maintenance of the channel at the mouth of the Sampit River. No work was done and no money expended under this authority prior to June 30, 1899. At that time some decrease in the width and depth of the original dredged cut appears to have occurred. Total expenditures to June 30, 1899, $42,980.71.

During the past year no work has been done. No marked change in the condition of the cut has been reported.

With existing balance it is proposed to redredge the channel at the mouth of Sampit River when found necessary.

July 1, 1899, balance unexpended	$1,519.29
July 1, 1900, balance unexpended	1,519.29

(See Appendix O 4.)

5. *Winyah Bay, South Carolina.*—This large bay is connected with the ocean by a passage between the shores of North and South islands 2½ miles long, 1 mile wide at the bay, three-fourths of a mile at its gorge, and 1¼ miles wide at the ocean or southeasterly end of North Island. Through the passage, which trends north-northwest and south-southeast, there is a bold channel 36 feet deep at the bay, retaining a depth of not less than 20 feet until about 3,000 feet southerly from the end of North Island and of not less than 15 feet to a point about 1 mile south of the island, where the channel divides into two. One of these two channels, known as the main ship channel, continues 3¼ miles farther, through extensive shoals, to the 18-foot contour in the ocean. This channel is south-southeast and in alignment with the bold channel through the straits. The other, known as Bottle Channel, after flowing about 2,500 feet southeasterly, 1,500 feet easterly, and about 3,000 feet northeasterly, before the improvement commenced, reached the 18-foot contour in the ocean at a distance of about 1½ miles in a direction from the point of separation from the main ship channel almost at right angles with the direction of that channel and of the channel through the passage. At mean low water the depth on the crest of the bar was variable in both channels and about 7 to 9 feet in the main channel and 6 to 8 feet in Bottle Channel. The mean range of tide is 3½ feet.

The original project adopted in 1889 provides for two jetties, springing, respectively, from North and South islands and converging toward the bar. They are to be constructed of mattress foundation, loaded with a stone superstructure composed of large riprap. The height of crest of each jetty is to be 6 feet above mean low water. The originally projected length of the north jetty was 10,700 feet, that of the south jetty 17,500 feet. Since the date at which the project was approved the shore lines and curves on the bar have changed so materially as to make it necessary to shift the positions of the jetties somewhat; as the project now stands the authority for such changes, without change in estimate, is given in the letter of the Chief of Engineers dated April 2, 1897. The depth to be secured is 15 feet at mean low water.

The total expenditures to June 30, 1899, were $743,073.26. At that time the following work had been done: On the north jetty the mattresses had been placed to a distance of 6,655 feet from the shore end, and the jetty had been built up to low water to a point 5,500 feet from the shore end, and to a height 18 inches above low water to a distance of 5,200 feet from the shore end. On the South Island side the spur jetties on the beach had been completed, a mud dike had been built to serve as a root for the south jetty, and this jetty had been carried out to a point 9,389 feet from the shore end, the outer 2,811 feet being only an apron of mattress and small stone, the remaining portion being built up to about mean high water, but with practically no top width. The seagoing pump dredge *Winyah Bay* had been completed, and had removed 172,976.77 cubic yards of material from the jetty channel. At that date the controlling depth was 11 feet, with a channel width of at least 500 feet. All jetty work done since June 30, 1896, has been under a continuing contract, providing for the completion of the jetties.

During the past year work under the contract for constructing the jetties was continued. On the south jetty the portion built to high-water level was extended 7,290 feet, and the mattress foundation to a point 4,195 feet farther seaward, the latter now reaching a point 18,063 feet from the shore end. The north jetty was extended 453 feet, none of the work being raised to high-water level, except that at a point where the jetty changed direction a small mound was built to mark this point. The material placed in the jetties during the year was 99,972.62 square yards of mattress, 49,093.03 tons of ballast stone, and 88,970.58 tons of large stone. The dredge *Winyah Bay* removed 337,217.97 cubic yards of material from the jetty channel.

The controlling depth on the outer bar has increased 2 feet during the year, being now 13 feet, but the channel has narrowed to an available width of about 200 feet. Over the inner bar the controlling depth is 11½ feet, with a channel width of about 500 feet.

The emergency river and harbor act approved June 6, 1900, contains the following item:

> Winyah Bay, South Carolina: The dredge or dredges employed in connection with the work of improvement at the entrance to Winyah Bay, and such other dredges owned or controlled by the Government as are used on Winyah Bay river systems and canals, may be used in dredging the shoal places between the entrance and the city of Georgetown, South Carolina, the places at which and depth to which such dredging shall be done to be determined by the Secretary of War, upon the recommendation of the Chief of Engineers, United States Army; and any expense so caused shall be paid from amounts heretofore appropriated for said Winyah Bay.

With existing balance it is proposed to pay the jetty contractor for work done during the fiscal year 1901, to continue dredging in the jetty canal, to complete the mud dike at the root of the south jetty, to dredge the shoals within the bay, as provided in the emergency river and harbor act approved June 6, 1900, and to pay cost of superintendence of above work. The continuing contract for jetty work does not cover the entire improvement provided for in the project, as it does not include dredging or work at the root of the south jetty.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	261,370	$8,071,600	1896	171,059	$6,228,350
1892	271,986		1897	119,374	5,817,950
1893	268,640		1898	125,003	5,587,880
1894	293,822		1899	120,587	6,337,853

July 1, 1899, balance unexpended		$564,176.74
Amount appropriated by sundry civil act approved June 6, 1900		285,000.00
		849,176.74
June 30, 1900, amount expended during fiscal year		292,441.96
July 1, 1900, balance unexpended		556,734.78
July 1, 1900, outstanding liabilities	$74,205.61	
July 1, 1900, amount covered by uncompleted contracts	754,224.74	
		828,430.35
Amount (estimated) required for completion of existing project		852,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		525,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 5.)

6. *Santee River, South Carolina.*—This river in its original condition was considerably obstructed at all stages of water by sunken logs and snags. Its bar entrance was narrow, crooked, and shifting, with only about 4 feet of water at low tide. Four steamers and a few vessels were then running upon portions of the river.

The project of 1880 proposed to provide the river with a good outlet through Mosquito Creek to Winyah Bay by deepening and straightening this creek to 50 feet width and 7 feet depth; to secure 7-foot navigation in the river from its mouth 120 miles to Wright Bluff, and thence 5-foot navigation 23 miles farther to its head in the Congaree and Wateree rivers.

The estimated cost was $104,427.40. At the same time the estimated cost of cutting a canal from Estherville plantation to Minim Creek, in lieu of the Mosquito Creek Canal, was $158,000. In 1887 the estimate was increased to $346,500.

The revised project of 1889 provides for leaving the Mosquito Creek Canal, which has been completed 30 feet wide and 3 feet deep, for a timber route, cutting a new canal between Estherville and Minim Creek large enough for river steamers, and snagging the entire river, at an estimated cost of $350,000,

The project of 1889 was submitted to Congress in the Annual Report of the Chief of Engineers for that year, page 1184.

The total expenditures to June 30, 1899, were $248,990.92. At that date the original width of the Estherville-Minim Creek Canal, 50 to 60 feet, and its original depth, 6 to 8 feet at low water, had been maintained. From the Santee River proper 1,025 snags and other similar obstructions had been removed.

During the past year 114,765 cubic yards of material has been dredged and 504 stumps and 12 logs removed from the Estherville-Minim Creek Canal, widening and deepening the first cut over a portion of the length of the canal. Extensive repairs were made to the dipper dredge belonging to this work. From the Santee River proper and its banks 1,258 obstructions were removed, the river being snagged to 123 miles above its mouth.

With existing balance it is proposed to continue dredging in the Estherville-Minim Creek Canal, and remove the worst snags that may appear in the Santee River proper. Under the estimate submitted in money statement below, it is proposed to widen and deepen the canal in accordance with the approved project, to maintain the width and depth gained, and to keep the Santee River proper clear of snags; also to make a survey of the river to determine amount of work required to complete the existing project. As a considerable part of the money appropriated has necessarily been expended in maintenance, a revision of the estimate for completion will have to be made, based on results of the proposed survey.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	100,255	$2,743,000	1896	134,135	$2,204,600
1892	110,523	2,775,800	1897	134,206	2,159,940
1893	124,182	2,679,600	1898	112,205	2,203,800
1894	115,428	2,375,000	1899	154,327	2,679,100
1895	117,690	2,224,800			

July 1, 1899, balance unexpended	$18,759.08
June 30, 1900, amount expended during fiscal year	12,016.76
July 1, 1900, balance unexpended	6,742.32
July 1, 1900, outstanding liabilities	710.88
July 1, 1900, balance available	6,031.44
Amount (estimated) required for completion of existing project	82,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	38,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 6.)

7. *Wateree River, South Carolina.*—In 1882 this stream, in its original condition, had a low-water depth of from 3 to 4 feet from its mouth, 67 miles, to Camden. The lower 14 miles was completely blocked at all stages of water by logs, snags, etc., and at moderate stages by the bridges of the South Carolina and the Wilmington, Columbia and Augusta railroads, then without drawspans; thence to Camden navigation was possible, but dangerous except during high water. Its commerce was practically nothing.

The project of improvement provides for safe and unobstructed 4-foot navigation for steamers from Camden to the mouth, at an estimated cost of $60,000.

Congress has made appropriations for maintenance since the project was completed.

The total expenditures to June 30, 1899, were $69,685.11. At that date the river was fairly well cleared of obstructions from the mouth to Camden, the head of navigation.

During the past year 862 obstructions have been removed from the river and banks. Since June 30, 1884, 24,912 obstructions have been removed. The records before that date do not give number of obstructions removed.

The river is deep and requires no dredging at any point, but it will require snagging annually, as its banks cave. The channel has been satisfactorily maintained throughout the year.

With existing balance it is proposed to continue snagging work. Under the estimate submitted in money statement below, it is proposed to keep the river thoroughly clear of obstructions.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	1,005	$51,210	1896	85,002	$233,525
1892	2,244	86,040	1897	43,770	202,800
1893	6,242	117,729	1898	83,568	274,050
1894	18,075	94,334	1899	109,170	272,200
1895	21,697	127,565			

July 1, 1899, balance unexpended	$2,814.89
June 30, 1900, amount expended during fiscal year	1,458.31
July 1, 1900, balance unexpended	1,356.58
July 1, 1900, outstanding liabilities	163.13
July 1, 1900, balance available	1,193.45
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	3,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 7.)

8. *Congaree River, South Carolina.*—In 1886 this stream, in its original condition, had a low-water depth of 3 to 4 feet from its mouth to the railroad bridge at Columbia; thence 1 foot low-water depth 2 miles farther to its head. Navigation of the lower 47 miles was blocked at all stages of water by the South Carolina Railroad Bridge, and by sunken logs, snags, and overhanging trees. The navigation of the remaining 2 miles was prevented by swift currents and numerous rock ledges and bowlders. Its commerce was nothing.

The project of improvement proposes to secure a thoroughly cleared 4-foot navigation over the lower 47 miles at all stages of water, and a cleared channel, 100 feet wide, through the shoals above, at an estimated cost of $54,500.

The total expenditures to June 30, 1899, were $30,673.52; no work had been done in the fiscal year ending on that date. Prior to June 30, 1898, the river had been thoroughly snagged from the mouth to Granby, 2 miles below Columbia, but no attempt had been made to improve the rapids above Granby. A snagging steamer had been built and 8,549 obstructions had been removed.

No work was done during the past fiscal year.

Some dredging will be needed to develop the full value of this stream and give the projected depth.

With existing balance it is proposed to remove the worst obstructions that may appear. Under the estimate submitted in money statement below, it is proposed to deepen and widen the channel to the dimensions contemplated by the approved project, working from the mouth up, and to keep the river clear of snags; also to make a survey of the river to determine amount of work required to complete the existing project. As a considerable part of the money appropriated has necessarily been expended in maintenance, a revision of the estimate for completion will have to be made, based on results of the proposed survey.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	2,401	$47,840	1896	18,307	$178,900
1892	3,686	62,025	1897	40,857	110,100
1893	2,781	71,125	1898	81,362	201,700
1894	7,974	40,760	1899	88,696	191,700
1895	8,993	45,700			

July 1, 1899, balance unexpended	$326.48
June 30, 1900, amount expended during fiscal year	.30
July 1, 1900, balance unexpended	326.18
Amount (estimated) required for completion of existing project	23,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 8.)

9. *Congaree River, South Carolina, from Gervais Street Bridge, Columbia, to Granby.*—Pursuant to House resolution dated December 15, 1893, a project and estimate was submitted and printed in House Ex. Doc. No. 66, Fifty-third Congress, second session, giving the cost of extending steamboat navigation from Granby to Gervais Street Bridge, Columbia. This document and a letter concerning it are reprinted on pages 1182–1189 of the Annual Report of the Chief of Engineers for 1896.

The river and harbor act approved March 3, 1899, authorized continuing contracts for constructing a lock and dam near Granby. The item of the act is as follows:

> Improving Congaree River, South Carolina, from Gervais Street Bridge, Columbia, to Granby, in accordance with plan submitted January second, eighteen hundred and ninety-four, fifty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete said improvement, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate two hundred thousand dollars, exclusive of the amount herein appropriated.

The total expenditures to June 30, 1899, under this provision of law were $45.10. At that date, condemnation proceedings for most of the land required had been instituted.

During the past year all the land required on both sides of the river was obtained, partly by condemnation proceedings and partly by purchase, the total cost, including incidental expenses, being $4,883.76 A contract for the construction of a lock keeper's house and other buildings was approved May 16, 1900, the contract price being $3,985.00. The construction of these buildings has been begun, and they are partially completed. In March, 1900, a careful survey of the proposed site of the lock and dam was made; plans and specifications for the construction of the lock, except metal work, and of the abutment of the dam have been completed and approved. Since March, 1900, two gauges have been maintained.

The sundry civil act approved June 6, 1900, contains the following item:

> Improving Congaree River, South Carolina: For continuing improvement from Gervais street bridge, Columbia, to Granby, one hundred thousand dollars.

There is at present no navigation on this part of the river.

July 1, 1899, balance unexpended		$49,954.90
Amount appropriated by sundry civil act approved June 6, 1900		100,000.00
		149,954.90
June 30, 1900, amount expended during fiscal year		4,866.60
July 1, 1900, balance unexpended		145,088.30
July 1, 1900, outstanding liabilities	$277.03	
July 1, 1900, amount covered by uncompleted contracts	3,985.00	
		4,262.03
July 1, 1900, balance available		140,826.27
Amount (estimated) required for completion of existing project		100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix O 9.)

10. Charleston Harbor, including Mount Pleasant and Sullivan Island shore, South Carolina.—There were originally four channels across the bar, the deepest having about 12 feet depth at low water. Commerce was then using the Pumpkin Hill Channel, about 3 miles south of the present jetty channel. Where the present jetty channel is situated there was then the swash channel, with a best depth of 10½ feet of water, too crooked for safe use. The natural channels were shifting in position and variable in depth.

In 1878 it was proposed to establish and maintain, by means of two jetties and auxiliary dredging, a low-water channel of not less than 21 feet depth across the bar. The swash channel was selected for improvement. The estimated cost was $3,000,000.

In 1888 it became necessary to modify the height of the crest line of the jetties and to revise the estimate. This increase in the estimate was largely due to the fact that money had been appropriated so slowly that reasonable contract prices could not be obtained. The annual appropriation up to that time had been only 5½ per cent of the original estimate. In the revised project the jetties were increased in height and length, but no change was made in their position or distance apart. The revised estimates were $4,380,500, if the jetties were brought up to low-water level throughout; and $5,334,500, if brought up 3 feet higher.

The total expenditures to June 30, 1899, were $4,037,256.70. At that date there was a channel of not less than 20 feet from Charleston to the ocean. The jetties had been completed in 1897.

During the past year the sea-going pump dredge *Charleston* has continued work except during the first three months, when she was undergoing repairs. The controlling depth at the entrance has been maintained at between 19.3 and 20.1 feet, and considerable progress has been made toward the removal of a shoal which obstructed the jetty channel near its inner end. The total amount of material dredged by her during the year is 253,401 cubic yards. The controlling depth over the outer bar is now practically 20 feet.[1]

The construction of a new and larger dredge to cost not more than $150,000 was authorized by the river and harbor act approved March

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[1] Soundings taken August 13, 1900, show a least depth at mean low water across outer bar of 22.4 feet, a gain of 3.2 feet since survey of July 2-3, 1900. Depths of 21.5 feet are found on the dredging range inside inner dredging buoy, but on a straight line making a very small angle with the dredging range a depth of 22.4 feet exists from the ocean to the deep channel between the outer ends of the jetties.

3, 1899, under an enlarged project submitted November 18, 1898, for obtaining 26 feet at mean low water. Plans and specifications for such a dredge having been prepared, bids for its construction were opened August 28, 1899. Owing to the congestion of work in the shipyards and the extremely high prices for materials then prevailing, but one complete bid was received. This was rejected, as the price named was excessive. Bids have not been again invited, as it was evidently necessary, under the limit of cost fixed, to first await a considerable fall in prices of shipbuilding and engine-building work.

The plans for the dredge are being revised, and it is intended to again call for bids in the near future in hopes a price within the limit of cost, $150,000, may be secured.

The original law—river and harbor act of March 3, 1899—authorizes the expenditure of $175,000 by contract, $150,000 for construction and $25,000 for operating. The latter amount can not well be used for operating a dredge under contract, and it would be to the interest of this work if the total amount, $175,000, could be used for construction.

An estimate of $60,000 for maintenance of this work is submitted. This amount will be required for operation of the dredge now provided for the work and for operating the new dredge yet to be constructed.

The sundry civil act approved June 6, 1900, contains the following items:

> Improving harbor at Charleston, South Carolina, under river and harbor act of eighteen hundred and ninety-two: For dredging, forty-five thousand dollars.
>
> * * * * * * *
>
> Improving harbor at Charleston, South Carolina: For completing improvement, one hundred and seventy-five thousand dollars.

The following proviso is contained in the emergency river and harbor act approved June 6, 1900:

> Charleston Harbor, South Carolina: The amounts heretofore authorized for a contract or contracts for materials and work, or so much thereof as may be necessary, may be expended in the work of dredging in accordance with the approved project.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1889	2,192,975	$76,073,600	1895	3,019,898	$70,247,003
1890	2,570,551	90,009,500	1896	3,317,497	79,325,016
1891	2,823,315	95,003,358	1897	1,015,140	12,106,763
1892	2,664,954	86,985,196	1898	997,158	10,956,250
1893	3,088,951	78,803,790	1899	1,018,366	6,385,168
1894	2,798,520	75,574,250			

July 1, 1899, balance unexpended	$90,243.30
Amount appropriated by sundry civil act approved June 6, 1900	220,000.00
	310,243.30
June 30, 1900, amount expended during fiscal year	86,232.59
July 1, 1900, balance unexpended	224,010.71
July 1, 1900, outstanding liabilities	6,174.85
July 1, 1900, balance available	217,835.86
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix O 10.)

11. *Wappoo Cut, South Carolina.*—Wappoo Cut, in its original condition, was a narrow, crooked tidal stream with not over 2 feet depth in some places. It connects Ashley and Stono rivers.

The original project provided for straightening, widening, and deepening, so that the finished channel should be 6 feet deep and 90 feet wide at low water. Jetties at the Ashley and Stono entrances and light bulkheads across three tidal tributaries were to be built. The estimated cost was $34,000.

This project was modified in 1889 to provide for a 60-foot width of channel, for a solid cut through the marsh, and for a wider and deeper cut through the Ashley River Bar, at a total cost of $88,000.

The total expenditures to June 30, 1899, were $61,215.85. There was probably a good 5½-foot channel through the cut at that date, and a very narrow 6-foot channel.

During the year no work has been done toward the completion of the project. An examination made June 29, 1900, shows that a 6-foot channel exists through the entire length, but it is very narrow in places.

With existing balance it is proposed to widen and deepen the channel at the most troublesome points; also to make a survey of the cut to determine amount of work required for completion of the project. Under the estimate submitted in money statement below, it is proposed to widen and deepen the channel, in accordance with the approved project, and to maintain the width and depth gained. As considerable deterioration of the dredged cut has undoubtedly occurred, a revision of the estimate for completion will probably have to be made, based on the results of the proposed survey.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	140,000	$1,976,000	1895	250,230	$2,260,100
1892		1,997,500	1896	271,800	2,410,000
1893	142,800	1,865,500	1899	235,830	2,005,695
1894	238,350	1,683,000			

July 1, 1899, balance unexpended	$1,284.15
June 30, 1900, amount expended during fiscal year	.24
July 1, 1900, balance unexpended	1,283.91
Amount (estimated) required for completion of existing project	25,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 11.)

12. *Beaufort River, South Carolina.*—There was originally a thoroughly good 7-foot channel between the town of Beaufort and Coosaw River, except at a point called Brickyard, near the Coosaw mouth. The least depth here was about 4 feet at low water, and the channel, when deep enough, was too narrow.

The plan of improvement adopted in 1890 was to deepen and widen the channel by dredging to give a continuous, sufficiently wide 7-foot channel at low water all the way through. The estimated cost was $25,000. A layer of rock having been encountered at a higher level than was found by the preliminary borings, the work could not be completed for the amount of the original estimate. On April 15, 1893, the estimate was increased to $40,000.

The total expenditures to June 30, 1899, were $30,431.71, securing a channel 7 feet deep all the way through, but it was much too narrow at the point where the rock was encountered. No work was done toward the completion of this project during the past year. The channel is now about 100 feet wide at the narrowest point.

The result of the dredging has been of great advantage to commerce in the way of safety, but to derive the full value of the improvement elsewhere the cut in the rocky portion must be made wider.

An examination was made during the year to determine whether material dredged from this river near the Port Royal Naval Station was being illegally dumped, and later a survey to define limits of the area that had been prescribed for dumping. Material found to have been illegally dumped is now being removed by the contractor.

With existing balance it is proposed to make a survey of the channel to determine present conditions; also to secure the removal of obstructions in the river. Under the estimate submitted in money statement below, it is proposed to widen the channel in accordance with the existing project and to maintain its width and depth. As considerable deterioration has probably occurred, a revision of the estimate for completion may have to be made, based on results of the proposed survey.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	202,235	$1,378,800	1895	174,800	$919,750
1892	250,000	1,505,000	1896	100,267	588,000
1893	215,000	1,181,000	1899	114,400	655,000
1894	193,985	950,000			

July 1, 1899, balance unexpended	$568.29
June 30, 1900, amount expended during fiscal year	109.59
July 1, 1900, balance unexpended	458.70
July 1, 1900, outstanding liabilities	17.50
July 1, 1900, balance available	441.20
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wreck of the pilot boat *Sprite*, which had been removed in March, 1899, was sold at auction during the year for $9, and the proceeds of the sale were deposited to the credit of the Treasurer of the United States.

A number of sunken logs, originally forming parts of rafts which had broken up, were reported as obstructing the "inland passage" between Charleston, S. C., and Beaufort, S. C. All the logs that could then be found were removed in May, 1900, at an expense of $554.77, using Government plant.

(See Appendix O 13.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. E. H. Ruffner, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Peter C. Hains, Corps of Engineers:

1. *Preliminary examination and survey of Lynchs River, South Carolina.*—Major Ruffner submitted reports dated June 8 and December 18, 1899, respectively. He presents a plan for improvement at an estimated cost of $68,750. In his opinion, concurred in by the division engineer, the locality is worthy of improvement as proposed. The reports were transmitted to Congress and printed in House Doc. No. 279, Fifty-sixth Congress, first session. (See also Appendix O 14.)

2. *Preliminary examination and survey of Sampit River, South Carolina, from its mouth at the 20-foot depth at low water in Winyah Bay, to its head of navigation, with the view of dredging shoals and removing other obstructions.*—Major Ruffner submitted reports dated June 8 and December 5, 1899, respectively, and a subsequent report of January 25, 1900, was submitted by his successor, Capt. J. C. Sanford, Corps of Engineers, the total estimated cost of improvement proposed being $737,387.99. Major Ruffner considers the locality worthy of improvement by the General Government, but the division engineer, for reasons given in his report, does not concur in this view, and he recommends for adoption only that part of the plan providing for deepening the river from Georgetown to the head of navigation to 6 feet. The reports were transmitted to Congress and printed in House Doc. No. 387, Fifty-sixth Congress, first session. (See also Appendix O 15.)

3. *Preliminary examination of the waterways and low-lying marsh lands or rice lands between the North and South Santee rivers, with a view to extending the Estherville-Minim Creek Canal in a southerly direction to Alligator River, South Carolina.*—Major Ruffner submitted reports dated June 8 and December 16, 1899, respectively. Plans are presented for improvement by two routes, estimated to cost $59,208.07 and $84,257.35, respectively, a slight preference being given for the route calling for the greater first cost. The local officer considers the locality worthy of improvement by the General Government, and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 278, Fifty-sixth Congress, first session. (See also Appendix O 16.)

4. *Preliminary examination and survey of Wee Tee Lake, South Carolina, from its junction with the Santee River to a point called the Bluff, with a view to make it navigable for steamboats.*—Major Ruffner submitted reports dated June 8 and December 18, 1899, respectively,

with plan for improvement at an estimated cost of $12,000. He considers the locality worthy of improvement by the General Government, and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 281, Fifty-sixth Congress, first session. (See also Appendix O 17.)

5. *Preliminary examination of waterways between Charleston Harbor and Alligator Creek, South Carolina.*—Major Ruffner submitted report dated July 28, 1899. A plan for improvement at an estimated cost of $281,600 is presented, and it is his opinion, in which I concur, that the locality is worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 84, Fifty-sixth Congress, first session. (See also Appendix O 18.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Great Pedee River, South Carolina, between Cheraw and the Wilmington, Columbia and Augusta Railroad Bridge.*
2. *Ashley River, South Carolina, from the city of Charleston to the head of navigation.*

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN GEORGIA, OF INSIDE WATER ROUTE BETWEEN SAVANNAH, GA., AND FERNANDINA, FLA., AND OF CUMBERLAND SOUND, GEORGIA AND FLORIDA.

This district was in the charge of Capt. Cassius E. Gillette, Corps of Engineers, having under his immediate orders Lieut. Lytle Brown, Corps of Engineers, to August 10, 1899. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. *Savannah Harbor, Georgia.*—This covers the estuary of the Savannah River from about 2 miles above the city of Savannah to the ocean bar, about 22 miles below the city. In 1873 the channel was in places not more than 9 feet deep at mean low water.

The original plan of improvement is dated August 28, 1873, and was supplemented March 19, 1879; it contemplates the establishment of a channel from the city to the sea practicable at high tide for vessels drawing 22 feet of water, and its cost was estimated at $481,320. This project was replaced by an enlarged one (January 16, 1882, Annual Report of the Chief of Engineers for 1882, Appendix J 4) contemplating the same channel depth, the cost being estimated at $1,212,000, including former appropriations.

A project, adopted in 1890, providing for a mean high-water depth of 26 feet from the city to the sea, is printed as part of Appendix O, Annual Report of the Chief of Engineers for 1890, its estimated cost being $3,500,000, exclusive of former appropriations. The work contemplated by it was reported practically completed at the end of the fiscal year of 1896, and since then only repair work and dredging have been carried on in accordance with it.

In compliance with requirements of the river and harbor act of August 18, 1894, a modified plan of improvement was submitted December 7, 1894, providing for a detached extension of the Oyster Bed training wall, for the purpose of sheltering the anchorage in Tybee Roads, as well as for protecting the ship channel over the outer part of Tybee Knoll against the destructive action of heavy storms. This project, which is printed as part of Appendix M 1 of the Annual Report of the Chief of Engineers for 1895, was authorized by act of Congress of June 3, 1896, its estimated cost being $992,250.

In connection therewith a project, dated January 22, 1895, for improving the inside route from Savannah, Ga., to Beaufort, S. C., at an additional cost of $106,700, was adopted by the same act, and the sum of $1,005,000 appropriated to complete both works, which was $93,950 less than their estimated cost.

The entire amount expended on the improvement of Savannah Harbor from its commencement to June 30, 1899, was $5,775,547.25.

For a summary of past work see page 1492 of the Annual Report of the Chief of Engineers for 1891; pages 1213 and 1218–1220 of the same report for 1896; page 1495, report for 1897; page 1293, report for 1898; and page 1561, report for 1899.

The amount expended under the project of 1890 up to June 30, 1896, was $3,460,049.99, of which $974,504.88 was for dredging and $2,356,720.10 for contraction work. There had been previously expended $1,875,061.59. The total amount expended up to June 30, 1896, was $5,335,111.58.

This work had resulted in a channel depth of about 20 feet at mean low water, obtained principally by dredging, and maintained to some extent by training walls. This channel, however, was narrow and crooked and has since shoaled quite rapidly.

From the time of the completion of this project, in July, 1896, until June 30, 1899, extensive dredging was done both as maintenance and as part of the modification of the project. Nevertheless, shoaling took place, the worst shoal being at the lower end of Long Island Crossing, where about 17½ feet at mean low water was reported. Considerable brush work had been done on the detached extension of Oyster Bed training wall, but this had no effect upon the navigable depth.

During the fiscal year just ended the contractors for jetty work have done no work. Their contract was annulled October 3, 1899. Under this contract the following amounts of work have been reported as done: 264,958.21 square yards of brush mattresses, at 95 cents, $251,710.30; 25,922.11 cubic yards of fourth-class rock, at $2.75, $71,285.80; making a total of $322,996.10. There has been paid them a total of $261,621.40, leaving a difference of $61,374.70 in their favor; but the materials were not in accordance with the specifications and the contract has been annulled. For this and other contracts in this district the United States has a valid claim against these contractors. The matter is in the hands of the United States Attorney-General for appropriate action.

Dredging has been continued throughout the year, 890,000 cubic yards of material having been removed since July, 1896. The removal of this large amount of material has just about kept up with the shoaling, and at the close of the year there is reported 19½ feet at mean low water on the worst shoal, which is at Tybee Knoll. Above the Ocean Steamship wharves there is 17 feet to the upper end of the harbor.

The inside route to Beaufort, through Mud River, was opened to a depth of about 6 feet.

The emergency river and harbor act of June 6, 1900, provides for a survey of Savannah Harbor, with a view to determining what changes of plan are necessary for securing a further deepening of channel.

In 1872 the tonnage of vessels arriving and clearing at Savannah Harbor was somewhat more than 1,000,000; the total value of imports and exports about $34,000,000. Cotton, lumber, wool, hides, naval stores, and rice were principally dealt in. In 1890 the total tonnage had increased to about 2,000,000, and the value of imports and exports to $152,000,000. Besides the articles named above, fruit, produce, and iron were handled extensively.

For the calendar year 1899 the total tonnage was about 2,837,076, and the value of foreign imports and exports about $26,077,862.

It is estimated that $50,000 will be required to maintain the improvement during the fiscal year ending June 30, 1902.

July 1, 1899, balance unexpended		$659, 349. 05
Amount received from Louisville and Nashville Railroad Company		1. 75
		659, 350. 80
June 30, 1900, amount expended during fiscal year		112, 298. 33
July 1, 1900, balance unexpended		547, 052. 47
July 1, 1900, outstanding liabilities	$43, 188. 40	
July 1, 1900, amount covered by uncompleted contracts	8, 709. 80	
		51, 898. 20
July 1, 1900, balance available		495, 154. 27
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		50, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix P 1.)

2. *Savannah River, Georgia.*—Appropriations under this title have been for that portion of the Savannah River between Savannah and Augusta. A detailed description of this portion of the river is found in the report of the survey between Augusta and Savannah, printed in the Annual Report of the Chief of Engineers for 1890, pages 1328–1363.

For the greater part of the year the river is navigable for steamboats drawing from 4 to 5 feet of water, but during the low-water season there are various shoals in the upper part of the river with low-water depths of less than 3 feet. The chief obstructions to navigation consist of sand and gravel bars, overhanging trees, snags, and sunken logs.

The original plan for improving Savannah River was submitted in 1880, and is given in Appendix J of the Annual Report of the Chief of Engineers for 1881.

The revised plan of improvement, as outlined in the local engineer's report of June 30, 1890, provides for the establishment of a navigable steamboat channel, 5 feet deep at ordinary summer low water, between the cities of Augusta and Savannah.

This is to be accomplished by (1) removing sand and gravel bars; (2) regulating portions of the river, revetting caving banks, and closing incipient cut-offs; (3) removing snags and logs from the channel, and overhanging trees from the banks of the stream.

The cost of the improvement as given in the project of 1890 is estimated, in round numbers, at $332,000, provided funds are regularly and adequately supplied.

From $3,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of the Savannah River between Savannah and Augusta, from its commencement in 1880 to the adoption of the project of 1890, was $93,480.09.

The total amount expended under the project of 1890 to June 30, 1899, was $89,883.92.

For a summary of the work done under the original project see page 1520 of the Annual Report of the Chief of Engineers for 1891. For a summary of the work done under the revised project see pages 1503 and 1504 of the same report for 1897, and page 1300 of the same report for 1898, and page 1561 of the same report for 1899. At the end of the fiscal year 1899 the channel from Savannah to Augusta was in fair condition, some snags requiring removal.

The project depth of 5 feet, however, could not be carried above Brighams Bar, 50 miles below Augusta.

The river and harbor act approved March 3, 1899, contains the following provision:

> Improving Savannah River between Augusta and Savannah: Continuing improvement, twenty thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for the materials and work that may be necessary to complete the existing project of improvement, namely: The project provided by the survey of eighteen hundred and ninety, and published in the Appendix to the Report of the Chief of Engineers, eighteen hundred and ninety, pages thirteen hundred and twenty-eight to thirteen hundred and sixty-three, or the required materials may be purchased and the work done otherwise than by contract, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate two hundred and fifty thousand dollars, exclusive of the amounts herein and heretofore appropriated.

Owing to the nature of the improvement proposed for Savannah River it is deemed more advantageous and economical to the Government to do the work by hired labor and the purchase of materials, and no continuing contract for carrying the work to completion has been entered into.

The work done during the fiscal year just closed resulted in removing from the channel the worst of the snags. Three training dikes were built which have apparently carried the project depth of 5 feet about 25 miles nearer Augusta. Further snagging is needed.

A detailed statement of the sources whence the commerce of this river is derived is given on page 1331 of the Annual Report of the Chief of Engineers for 1890. Further information is given on page 1504 of the report for 1897.

After the close of the civil war and prior to the improvement the commerce of the river was unimportant. Since then it has increased. The exports from the river valley are mainly cotton, naval stores, lumber, and wood, while the imports are fertilizers, camp and mill supplies, cotton ties and bagging, and manufactured articles. Excluding logs, timber, and cord wood, the tonnage for the year 1899 amounted to 34,950 tons, valued at about $3,500,000. During the year 1899 5,000,000 feet B. M. of timber, valued at about $150,000, was carried on the river.

July 1, 1899, balance unexpended	$20,135.99
Amount appropriated by sundry civil act approved June 6, 1900	64,000.00
	84,135.99
June 30, 1900, amount expended during fiscal year	12,129.91
July 1, 1900, balance unexpended	72,006.08
Amount (estimated) required for completion of existing project	186,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 2.)

3. *Savannah River above Augusta, Georgia.*—The Savannah River is formed by the junction of the Tugaloo and the Keowee rivers, and flows in a southeasterly direction to the sea. Above the city of Augusta the river is navigable only by pole boats.

A detailed description of the river is given in the report of the preliminary examination and survey, printed in the Annual Report of the Chief of Engineers for 1890, pages 1484 and 1525.

The stream here has a very steep slope, and the obstacles to navigation are not only very numerous and extensive, but at places quite dangerous. They consist of rock ledges, isolated bowlders, and bars of sand and gravel, with minimum low-water depths of less than 1 foot.

The original plan for improvement is given in Appendix I of the Annual Report of the Chief of Engineers for 1879.

The revised plan of improvement, as outlined in the local engineer's report of January 31, 1890, provides for the establishment between Petersburg and the Locks of a downstream channel 12 to 25 feet in width and navigable during ordinary summer low water (or from nine to ten months of every year) for pole boats drawing 2 feet, and of an upstream channel navigable under the same conditions for pole boats drawing 1.3 feet of water. This is to be obtained by (1) removing logs and overhanging trees; (2) excavating rock, sand, or gravel, and with excavated materials raising crests of ledges; (3) constructing training walls to increase flow of water through sluices. The cost of improvement is estimated at $23,000, provided the money is all made available at once, or at $33,000 if supplied in smaller amounts.

The entire amount expended on the improvement of the Savannah River above Augusta from the commencement in 1880 to June 30, 1899, was $54,770.91.

The total amount expended under the present project, up to June 30, 1899, was $15,770.91. For a special history of work done under the original project see page 1032 of the Annual Report of the Chief of Engineers for 1888. For a summary of the work done under the revised project see pages 1506 and 1507 of the report for 1897.

At the close of the fiscal year 1899 the channel above Augusta was in fair condition. Some snags required removal and shoals needed attention.

Work during the year consisted in blasting out channels through shoals and removing overhanging trees. A very decided improvement in the channel was made.

In 1876–77 about 2,000 tons of freight went upstream from Augusta and about 12,000 bales of cotton came down. In the report of 1888 the down-going freight was estimated at about 5,000 bales of cotton, and in 1898 the total freight carried on the river, excluding timber, amounted to about 5,570 tons, valued at $200,000.

July 1, 1899, balance unexpended	$4,229.09
June 30, 1900, amount expended during fiscal year	3,624.33
July 1, 1900, balance unexpended	604.76
Amount (estimated) required for completion of existing project	13,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 3.)

4. *Doboy Bar, Georgia.*—In 1888 $5,795.40 was spent in harrowing and water-jet work on this bar without result. In its present condition there is about 12 feet at mean low water in the old channel, which is very crooked, so that the entrance is not much used. The project for its improvement, adopted by act of Congress of March 3, 1899, provides for creating a channel by dredging 24 feet deep at mean high water and 300 feet wide, estimated to cost $70,000.

Dredging under contract began April 9, 1900. At the close of the fiscal year 47,000 cubic yards of material had been removed.

The amount expended to June 30, 1899, was $960.79.

The funds appropriated will complete the channel and maintain it until June 30, 1901. To maintain it the following year it is estimated that $30,000 will be necessary. The exact amount can not be estimated, as the conditions are uncertain, but enough to insure the maintenance of the channel for this period is very essential to avoid the loss of the money used in creating the channel, since, if it is maintained for a reasonable time, the tidal currents will seek it—possibly scour it deeper. This will cause less water to flow through the present channel to the southward, and that channel will shoal, thereby giving the new channel a better chance to become self-maintaining.

July 1, 1899, balance unexpended		$69,039.21
June 30, 1900, amount expended during fiscal year		4,719.30
July 1, 1900, balance unexpended		64,319.91
July 1, 1900, outstanding liabilities	$3,178.85	
July 1, 1900, amount covered by uncompleted contracts	43,448.42	
		46,627.27
July 1, 1900, balance available		17,692.64
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix P 4.)

5. *Darien Harbor, Georgia.*—That portion of Darien River between Darien and Doboy Sound is known as Darien Harbor. Its length is 9 miles. In its original condition it was more or less obstructed at seven points by shoals, on which were found minimum mean low-water depths of from 6.4 to 10.6 feet. The reaches between the shoals carried depths nowhere less than 12 feet at mean low water. The mean rise and fall of the tide in the harbor is about 6½ feet.

Operations for improving this harbor have been carried on in accordance with a project of improvement printed in the Annual Report of the Chief of Engineers for 1885. It contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy. The estimated cost of the improvement is $170,000. No work was done under this project prior to the fiscal year ending June 30, 1891.

The total amount expended under the present project up to June 30, 1898, was $95,000. There had been expended under a previous project for dredging $8,000, making a total of $103,000.

For a summary of past work see pages 1508 and 1509 of the Annual Report of the Chief of Engineers for 1897.

At the end of the fiscal year 1899 the dredging had maintained fairly well. The spur dams constructed had apparently been of little effect and were practically gone. During the past year there was removed by dredging under contract 69,790.3 cubic yards of material at a cost of $9,561.26. The channel needs further dredging, especially that portion leading to the Lower Ridge Mill.

The ingoing and outgoing tonnage for 1878 was estimated at about 200,000, and the value of the exports at between $600,000 and $700,000. In 1899 the total annual trade, consisting mostly of timber, was estimated at about 146,000 tons, valued at about $920,382.

July 1, 1899, balance unexpended	$10,000.00
June 30, 1900, amount unexpended during fiscal year	9,033.42
July 1, 1900, balance unexpended	966.58
July 1, 1900, outstanding liabilities	956.12
July 1, 1900, balance available	10.46
Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 5.)

6. *Altamaha River, Georgia.*—The Altamaha River is formed by the junction of the Oconee and Ocmulgee rivers in the southeastern part of Georgia and flows in a southeasterly direction to the sea.

A detailed description of this river is given in the report of a survey dated June 12, 1890, which is printed in the Annual Report of the Chief of Engineers for 1890, pages 1372–1386.

The chief obstructions to the navigation of the Altamaha River consist in rock ledges, sand bars, snags, sunken logs, and overhanging trees. The rock ledges were confined to the upper portion of the stream, while the other obstructions were found throughout its entire course. The low-water depths at some points did not exceed 1 foot.

The original plan for improving the Altamaha River was submitted in 1880, and is given in Appendix J of the Annual Report of the Chief of Engineers for 1881.

The revised plan of improvement, outlined in the local engineer's report of June 12, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water between the junction of the Oconee and Ocmulgee rivers and the town of Darien.

This is to be accomplished by (1) removing rock shoals and sand bars; (2) building deflecting dikes and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream; and (4) revetting caving banks.

The cost of the improvement as given in the project of 1890 is estimated, in round numbers, at $129,000, provided funds are regularly and adequately supplied.

From $3,000 to $5,000 will be required for the annual maintenance of the completed work.

For a history of work done under the original project, see page 1246 of the Annual Report of the Chief of Engineers for 1889. For a summary of work done under the revised project, see page 1514 of the report for 1897.

At the close of the fiscal year 1899 the river was not in good condition.

The amount expended under the present project for this river up to June 30, 1899, was $48,717.65. There had been previously expended $69,776.59, making a total of $118,494.24.

During the fiscal year just ended a channel was cut through the rock ledge at Town Bluff Shoals, a training dike built at Griners Bar and some work done to encourage a cut-off at Beards Bluff.

Navigation on this river is still materially obstructed. Work is urgently needed at Coupers Bar, Sisters Bluff, Beards Bluff, Carters Bight, and Cypress Nursery. An allotment of $2,000 from appropriation made by emergency river and harbor act of June 6, 1900, for work on this river was made July 7, 1900, and a further allotment of $7,000 was made September 14, 1900.

The commerce of the river before the improvement was begun amounted to about 100,000 tons annually, valued at about $1,000,000. During the year 1899 it is estimated to have amounted to about 17,000 tons, valued at about $1,025,000, and 160,000,000 feet B. M. of timber, valued at $1,500,000.

Extensive deterioration has taken place in the works at Coupers Bar and at Marrowbone Bar, and it is estimated that to repair these structures or replace them will cost $8,000.

July 1, 1899, balance unexpended	$7,505.76
June 30, 1900, amount expended during fiscal year	4,263.60
July 1, 1900, balance unexpended	3,242.16
July 1, 1900, outstanding liabilities	2,250.10
July 1, 1900, balance available	992.06

Amount (estimated) required for completion of existing project	101,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	26,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix P 6.)

7. *Oconee River, Georgia.*—The Oconee River rises in the northeastern part of Georgia and flows in a southeasterly direction and unites with the Ocmulgee River to form the Altamaha. A detailed description of the river is printed in the Annual Report of the Chief of Engineers for 1890, pages 1430 and 1432.

For the greater part of the year the river is navigable for steamboats drawing from 3 to 4 feet, but during the low-water season there are various shoals with low-water depths of not more than 2 feet. The chief obstructions to navigation consist of sand bars, rock shoals, snags, sunken logs, and overhanging trees.

The original plan for improving the Oconee River was submitted in 1875, and is given in the Annual Report of the Chief of Engineers for that year. That plan was modified in 1878, 1880, and 1888.

The present plan of improvement, outlined in the report of February 5, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water from Milledgeville to the river's mouth.

This is to be accomplished by (1) removing rafts, rock shoals, and sand bars; (2) enlarging portions of the river, revetting caving banks, and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement is estimated at $171,000.

From $1,000 to $5,000 will be required for annual maintenance of the completed work.

For a history of the work done under the original project see page 1253 of the Annual Report of the Chief of Engineers for 1889. For a summary of the work done under the present project see pages 1516 and 1517 of the report for 1897, and page 1309 of the report for 1898.

The amount expended under the present project to June 30, 1899, was $71,552.31. There had been previously expended $44,822.18, making a total of $116,374.49.

At the close of the fiscal year 1899 the channel was not in good condition. Numerous snags needed removal; an injurious cut-off was making at Bonny Clabber, and there were several bad rock shoals above Dublin.

During the past fiscal year snags were thoroughly removed from the upper half of the river, and the wing dam at Lattimers Reach repaired. An allotment of $2,000 from appropriation contained in the emergency river and harbor act of June 6, 1900, was made July 7, 1900, for work on this river.

No reliable statistics of the commerce of the river before the improvement was begun are available. From 1880 to 1885 the information at hand only mentions cotton, guano, rosin, spirits of turpentine, and merchandise, all of these in considerable quantities.

In 1899 the amount of freight carried on the river was estimated at 10,000 tons, valued at $505,000. Besides this, 75,000,000 feet B. M. of timber was shipped down the river, valued at $700,000.

July 1, 1899, balance unexpended	$8,625.51
June 30, 1900, amount expended during fiscal year	6,408.48
July 1, 1900, balance unexpended	2,217.03
July 1, 1900, outstanding liabilities	820.72
July 1, 1900, balance available	1,396.31
Amount (estimated) required for completion of existing project	112,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	22,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix P 7.)

8. *Ocmulgee River*, *Georgia.*—The Ocmulgee River is formed by the junction of the South and Yellow rivers, about 20 miles below Covington, and flows thence in a southeasterly direction about 250 miles, where it unites with the Oconee to form the Altamaha. A detailed description of this river is found in the report of the preliminary examination and survey, printed in the Annual Report of the Chief of Engineers for 1890, pages 1455–1458.

For the greater part of the year the river is navigable for steamboats drawing from 3 to 4 feet, but during the low-water season there are various shoals with depths of not more than 2 feet. The chief obstructions to navigation consist of rock shoals, sand bars, snags, sunken logs, and overhanging trees,

The original plan for improving Ocmulgee River was submitted in 1876, and is given in the Annual Report of the Chief of Engineers for that year. That project was revised in 1882 and again in 1886.

The present plan of improvement, outlined in the report of February 5, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water from Macon to the river's mouth.

This is to be obtained by (1) removing rock shoals and sand bars; (2) closing incipient cut-offs and revetting caving banks; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement, as given in the project of 1890, is estimated at $210,000, provided funds are regularly and adequately supplied.

From $1,000 to $5,000 will be required for the annual maintenance of the completed work.

For a detailed history of the work done under the original project see page 1258 of the Annual Report of the Chief of Engineers for 1889. For a summary of the work done under the present project see pages 1519 and 1520 of the report for 1897, and pages 1311 and 1312 of the same for 1898.

The amount expended under the present project up to June 30, 1899, was $76,842.54. There had been previously expended $79,390.73, making a total of $156,233.27.

The emergency river and harbor act approved June 6, 1900, contains the following provision:

> Ocmulgee River, Georgia: The provision in the river and harbor act approved March 3, 1899, authorizing contracts to be made for improving Ocmulgee River is hereby amended to read as follows: "*Provided*, That a contract or contracts may be entered into by the Secretary of War to complete the present project of improvement, or the required materials may be purchased and the work of improvement be carried on otherwise than by contract, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one hundred and thirty-six thousand dollars, exclusive of amounts herein and heretofore appropriated."

Owing to the nature of the improvement proposed for the Ocmulgee River, it is deemed more economical and advantageous to the Government to do the work by hired labor and purchase of materials, and no continuing contract for the completion of the project has been entered into.

No reliable statistics of the commerce of the river before the improvement was begun are available. It is stated in 1889 to have consisted principally of naval stores, cotton, merchandise, camp supplies, etc., and also of timber rafted down the river. In 1887–88 about 14,300 barrels of turpentine and 50,700 barrels of rosin are stated to have been shipped, while probably $300,000 worth of timber was rafted down the river.

In 1899 the tonnage was estimated at 24,000 tons, valued at $1,250,000 besides 50,000,000 feet B. M. of timber carried down the river, valued at $425,000.

July 1, 1899, balance unexpended	$18,266.73
Amount appropriated by sundry civil act approved June 6, 1900	40,000.00
	58,266.73
June 30, 1900, amount expended during fiscal year	17,213.95
July 1, 1900, balance unexpended	41,052.78
July 1, 1900, outstanding liabilities	881.57
July 1, 1900, balance available	40,171.21
Amount (estimated) required for completion of existing project	96,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 8.)

9. Brunswick Harbor, Georgia.—The lower part of East River, a branch of St. Simon Sound, forms what is known as the harbor of Brunswick.

Over the shoal in East River in front of the lower edge of the city there was, when the existing project of improvement was adopted, a low-water depth of only 1½ fathoms. The mean rise and fall of the tide is about 6.6 feet. Operations for the improvement of this harbor have been carried on in accordance with a project of improvement printed as Appendix M 12, Annual Report of the Chief of Engineers for 1886. This project is an enlargement and a modification of a previous one printed as Appendix J 7, Annual Report of the Chief of Engineers for 1880.

The following comprise the main features of the plan of improvement:

(1) A training wall projecting from the most easterly point of Buzzard Island and located approximately parallel to and 1,000 feet or less distant from the opposite shore of East River.

(2) A low dam across Turtle River extending obliquely upstream from the upper end of Buzzard Island to the opposite shore of Blythe Island.

(3) Short spur jetties in the lower part of East River.

(4) Dredging in the vicinity of Turtle River Dam and on the shoal in the lower part of East River.

The training walls and spurs were to be constructed of palmetto cribs loaded with stone, or of successive courses of log and brush mattresses loaded with riprap stone. The works were intended to establish and maintain a 15-foot low-water channel across the shoal in East River. The cost of the original project was estimated at $73,187.50, and as modified at $190,000.

In his report of November 26, 1894, concerning a revision of the project of improving harbor at Brunswick, the local engineer stated that—

> It will be more economical and advantageous to maintain the desired depth of 15 feet at mean low water by keeping the training wall in good condition and by annual dredging than by constructing a dam across Turtle River and further channel contraction.

He also estimated the cost of maintenance at $15,000 per annum, provided that sum be made available each year.

The river and harbor act of March 3, 1899, provided for a preliminary examination and survey of this harbor with a view to further improvement. This examination has been made, and reports of results were submitted to Congress and printed in House Doc. No. 40, Fifty-sixth Congress, first session; they are also herewith as Appendix P 13.

For a summary of past work, see page 1274 of the Annual Report of the Chief of Engineers for 1896, page 1523 of the report for 1897, page 1314 for 1898, and page 1585 for 1899.

Up to June 30, 1899, there had been expended under the present project for maintenance $24,853.97; there had been expended previously $200,000, making a total of $224,853.97, including $10,000 spent in 1836 for dredging.

At the end of the fiscal year 1899 item 1 of the project was completed and the lower part of East River had been dredged to 15 feet. Items 2 and 3 and the dredging in Turtle River had not been done. The channel was not self-maintaining.

No work was done during the past fiscal year. The channel has deteriorated and a contract was made for dredging.

Before the improvement (in 1880) the annual tonnage of the port of Brunswick was about 100,000, consisting chiefly of lumber, naval stores, wood, rice, and sundry provisions, and valued at about $1,700,000. In 1899 the shipments of lumber and merchandise amounted to 697,392 tons, valued at $21,375,486.

July 1, 1899, balance unexpended	$10,146.03
June 30, 1900, amount expended during fiscal year	714.63
July 1, 1900, balance unexpended	9,431.40
July 1, 1900, amount covered by uncompleted contracts	8,905.00
July 1, 1900, balance available	526.40
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix P 9.)

10. Inside water route between Savannah, Ga., and Fernandina, Fla.—The location of this route is shown by a dotted line on Coast Survey Charts Nos. 156 and 157, and a detailed description of it and its original condition is given in the Annual Report of the Chief of Engineers for 1892, pages 1311–1326.

The distance from Savannah to Fernandina by the inside route just described is about 160 miles.

Touching at Darien en route increases the distance by about 20 miles, and at Brunswick by about 12 miles.

In its original condition the channel depth was less than 5 feet at mean low water in some places.

The original project of improvement, adopted in 1892, provides for the establishment of a channel 7 feet deep at mean low water between Savannah, Ga., and Fernandina, Fla. This is to be accomplished by the improvement of Romerly Marsh, Mud River, Little Mud River, and Jekyl Creek, by means of dredging and the construction of closure dams and training walls of brush mattresses loaded with riprap stone. The estimated cost of the improvement is $105,000, provided that the entire sum is made at once available. If funds are made available in smaller amounts the cost of the improvement will be increased.

Previous to the adoption of this project, work had been done on what is now part of the inside route in opening Parsons Cut through Romerly Marshes.

A history of this work will be found on page 1368 of the Annual Report of the Chief of Engineers for 1890. A summary of the operations under the present project will be found on page 1536 of the Annual Report of the Chief of Engineers for 1897, and on pages 1318 and 1319 of the report for 1898.

The total amount expended on the inside-route project up to June 30, 1899, was $48,864.41; previous to this, $71,108.77, making a total of $119,973.18.

At the end of the fiscal year 1899 the depth of cut through Romerly Marshes had deteriorated to about 3½ feet, but had increased in width. The channel in Jekyl Creek had deteriorated to 5 feet. The cut through Mud River had not been completed.

The value of the commerce passing through this route was estimated in 1890 at between $200,000 and $400,000 per annum. For 1899 it is estimated at about 50,000 tons of merchandise, valued at $2,250,000, and 175,000,000 feet, B. M., of timber, valued at $1,950,000. None of this commerce passed over the whole extent of the route.

July 1, 1899, balance unexpended	$135.59
June 30, 1900, amount expended during fiscal year	3.00
July 1, 1900, balance unexpended	132.59
Amount (estimated) required for completion of existing project	56,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	22,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix P 10.)

11. Cumberland Sound, Georgia and Florida.—[This work was in the charge of Capt. C. H. McKinstry, Corps of Engineers, until May 24, 1900.] The available depth of the entrance in its unimproved condition varied from 11 to 12.5 feet at mean low water. The mean rise and fall of tide is 5.9 feet. The original plan of improving the entrance was submitted in 1879, and is given in the Annual Report of the Chief of Engineers for that year. A revised plan was submitted in 1891. A second revision of the plan of improvement was submitted in 1895, and is printed in the Annual Report of the Chief of Engineers for 1896, page 1289 et seq. It contemplates the construction of two jetties, composed of riprap stone, with a hearting of small stone, resting upon a foundation mattress of brush, starting, respectively, from the shores on opposite sides of the entrance and extending seaward across the bar. These jetties are intended to establish a mean low-water channel across the bar not less than 19 feet in depth.

The cost of the improvement was originally estimated at $2,071,023, as revised in 1891 at $2,079,500, and as revised in 1895 at $2,350,000 for completion. The project as revised in 1895 was authorized by the river and harbor act of June 3, 1896, which authorized a continuing contract for the entire amount of the estimate.

Previous to the adoption of the project of 1895 the sum of $932,500 had been expended on the improvement, resulting in carrying the foundations and part of the jetty structures, of the north jetty 18,308.8 feet, and of the south jetty 10,062.48 feet seaward.

Under the provisions of the river and harbor act of June 3, 1896, a contract was entered into October 8, 1896, for all jetty work required for completion of the improvement. Work was commenced on December 7, 1896, and continued to October 9, 1897, since which date no work was done. The contract was annulled October 6, 1899.

Under this contract up to June 30, 1898, work had been done on the north jetty between Station 18261 and Station 20412.4 and on the south jetty between Station 10062 and Station 13854.7. There had been used in this work 458,156.47 square yards of mattresses, 9,813.59 cubic yards of third-class stone, and 17,840.03 cubic yards of fourth-class stone. These quantities are those reported, but the materials have been shown not to be up to the specifications; the officer formerly in charge of the work has been convicted of conspiracy with the contractors to defraud the United States, and the contractors are under indictment for the same offense.

At contract prices the work performed by the contractors as above stated amounts to $604,685.21. The contractors have been paid $345,000. The balance of $259,685.21 is by the annulment of the contract forfeited to the United States.

The total amount expended on the improvement of Cumberland Sound up to June 30, 1899, was $1,328,866, of which $396,366 was under the project of 1895 and the provisions of the river and harbor act of June 3, 1896.

The jetties as now existing do not control the channel location, the sailing line being still across the line of the south jetty. A new channel, however, is opening between the jetties.

From the map of the survey made in June, 1900, it appears that a channel 19 feet deep exists through the jetty crossing out to sea, excepting a shoal on the outer bar, where there is a depth of 16 feet for a very short distance.

There has been a marked further development of the channel which is forming between the jetties. During the year the 12-foot contour in this channel advanced seaward about 400 feet. While there is less than 7 feet at mean low water at the shoalest places, the distance across the shoalest place is less and the channel is generally deeper.

There appears to have been little or no change in the condition of the jetties.

The existing project is now under consideration of a Board of Engineer Officers and work will be resumed at an early day.

Before improvement (in 1879) the annual in and out bound tonnage at Fernandina was about 300,000, and the value of imports and exports about $2,500,000, lumber, naval stores, and cotton being the principal articles. In 1899 the total value of imports and exports, coastwise and foreign, was reported by the collector of customs as $3,861,992.

July 1, 1899, balance unexpended	$858,634.00
June 30, 1900, amount expended during fiscal year	4,799.83
July 1, 1900, balance unexpended	853,834.17
July 1, 1900, outstanding liabilities	1,117.46
July 1, 1900, balance available	852,716.71
Amount (estimated) required for completion of existing project	1,095,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the fiscal year just ended there was removed, under authority of the Secretary of War, the wreck of the bark lighter *Cypher*, from Savannah Harbor, the work being done by hired labor at a cost of $23.33.

Authority was also given for the removal of the wreck of a sunken lighter from Savannah River. This wreck has not yet been removed.

(See Appendix P 12.)

EXAMINATION AND SURVEYS AT BRUNSWICK, GA., REQUIRED BY THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of the *inner harbor at Brunswick, Ga.*, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. Cassius E. Gillette, Corps of Engineers, and reports thereon dated March 27 and October 14, 1899, respectively, submitted. A plan for improvement at an estimated cost of $125,700 is presented. The reports were transmitted to Congress and printed in House Doc. No. 40, Fifty-sixth Congress, first session. (See also Appendix P 13.)

Captain Gillette was also charged with the duty of making a survey of *Brunswick Outer Bar, Ga.*, required by the river and harbor act of March 3, 1899, and, if possible, report on the results will be submitted in time for transmission to Congress at its next session.

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Savannah Harbor, Georgia, with a view to a reexamination of the plan for deepening said harbor, as submitted in the Report of the Chief of Engineers for 1898 and a report as to what changes or modifications, if any, are necessary to carry out said plan.*
2. *Skiddaway Narrows, South Carolina, connecting the Isle of Hope River with Burnside River, for a channel 75 feet wide and 6 feet deep at mean low water.*

IMPROVEMENT OF RIVERS AND HARBORS ON THE EAST COAST OF FLORIDA AND OF HARBOR AT KEY WEST, FLA., AND ENTRANCE THERETO.

This district was in the charge of Capt. C. H. McKinstry, Corps of Engineers, to May 24, 1900, and in the temporary charge of Capt. Thomas H. Rees, Corps of Engineers, since that date, with Lieut. Edward M. Markham, Corps of Engineers, under their immediate orders. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. St. Johns River, Florida.—Previous to the commencement of improvement the mean low-water channel depth across the bar at the mouth varied from 5 to 7 feet, with a tidal range of 5.22 feet. This bar is formed of sand, and was extremely dangerous, as the channel across it shifted continually north and south through a range of about 1 mile.

The least mean low-water channel depth in the river was about 11.5 feet, all obstructions being sand or mud. The tidal range in the river varies from about 4.5 feet at the mouth to about 1 foot at Jacksonville.

The original plan of improvement contemplated the formation of a continuous channel with a mid depth of not less than 15 feet at mean low water from Jacksonville to the ocean, a distance of about 27.5 miles. The two points where work was required to gain this depth were at the bar at the mouth and in a reach of the river near Dames Point, 12 miles above. The work was divided into two parts:

1. The formation of a channel across the bar at the mouth by the concentration and direction of the tidal currents by two jetties to start from the opposite shores at the entrance, and to converge until, on the bar, their outer ends should be approximately parallel and 1,600 feet apart.
2. The improvement of the Dames Point reach by dredging, and the construction of works of protection, under a project approved June 11, 1891, and modified March 28, 1892.

It was estimated that the cost of obtaining a channel over the bar 15 feet in depth at mean low water under the approved project would be $1,306,409, and for improving the river in accordance with the approved modified project, which contemplated a navigable channel of 18 feet mean low-water depth from inside the bar to Jacksonville, would be $324,000.

Improvement of the river between the bar and Jacksonville was effected by the citizens of Duval County, Fla., at a cost of $303,206.25, and consisted of forming a channel 200 feet wide and 18 feet deep at low water by dredging and construction of training dikes.

The work done on this river and bar having been in a marked degree successful, and having demonstrated the possibility of obtaining a channel of much greater depth than that originally contemplated, a plan was submitted, under authority of the river and harbor act of August 18, 1894, for continuing the work of improvement with a view of obtaining a channel depth of 24 feet from Jacksonville to the ocean. This project contemplates the dredging of a channel 300 feet wide and 24 feet deep through all shoals, and the construction of training dikes in the river proper, at an estimated cost of $600,000; also the extension of the north jetty at the mouth of the river 1,500 feet, and of the south jetty 500 feet, and raising these jetties throughout their entire length, at an estimated cost of $1,509,750; in all, $2,109,750. This project was adopted by the river and harbor act of June 3, 1896.

The amount expended on this improvement by the United States up to June 30, 1899, was $1,568,656.02, of which $151,656.02 was under the present project, adopted by the river and harbor act of June 3, 1896.

At the close of the fiscal year ending June 30, 1899, the north jetty had been partially completed for a length of 10,934 feet. Its crest from shore out varied from 3 feet above to 3 feet below mean low water, averaging 2 feet below, excepting at Station 7600, where it was 5 feet below, and at Station 9100, where it was 8 feet below; from Station 9700 to near the outer end the crest rose from 2 feet above to 5 feet above mean low water. The south jetty was partially completed for a length of 10,712 feet. Its crest from shore out to Station 7900 varied from 6 feet to 3 feet, averaging 4½ feet, above mean low water; from Station 7900 to the outer end the crest sloped gradually from 3 feet above to 2 feet below mean low water. There was a channel across the bar with an available depth of 13½ feet at mean low water. In the river above the mouth two of the dredged cuts had shoaled very materially and had changed their locations. The available river depth was 14 feet.

The work done during the past fiscal year consisted of the extension of the north jetty 1,000 feet to Station 11934, this extension having a crest width of 35 feet at an average depth of 3 feet below mean low water. The raising of the inner portion of this jetty was also commenced. Between Stations 3467 and 3588 it was raised to an average height of 3 feet above mean high water line. No work was done on the south jetty. With the U. S. dredge *Cape Fear*, borrowed from the Wilmington, N. C., district, the four cuts in the river above the mouth, formerly made by Duval County, were redredged to a depth of 16 feet at mean low water, which depth will later be increased to 18 feet if the dredge *Cape Fear* remains available and funds on hand are sufficient.

With the exception of the results obtained by work done during the year, and a subsidence near the inner end and between Stations 1500 and 3100 on the north jetty, there was practically no change in either jetty during the year. A decided improvement in the condition of the bar has taken place. A straight channel of 14.2 feet can be found across it and the general depth throughout is better. The dredging done in the river above the mouth permits a draft of 16 feet to be carried to Jacksonville at mean low water.

The officer in charge invites attention to the fact that at the present rate at which appropriations are made for this improvement, twenty-two years must elapse before the amount which it is estimated will be required to complete the present project will have been appropriated. He recommends that the work be put under the continuous-contract system, or that much more liberal appropriations be made. The projected dredging and construction of training walls and dikes in the river proper can not well be carried on simultaneously with jetty work with such small appropriations as have heretofore been made.

With the existing balance of funds, it is proposed to extend and build up the north jetty and to dredge in the river and on the bar if necessary. With such appropriation as may be granted for the year 1902, the extension and raising of jetties and dredging will be continued.

July 1, 1899, balance unexpended		$248, 343. 98
June 30, 1900, amount expended during fiscal year		31, 816. 95
July 1, 1900, balance unexpended		216, 527. 03
July 1, 1900, outstanding liabilities	$23, 324. 58	
July 1, 1900, amount covered by uncompleted contracts	162, 109. 81	
		185, 434. 39
July 1, 1900, balance available		31, 092. 64

Amount (estimated) required for completion of existing project	1, 709, 750. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	400, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 1.)

2. St. Johns River at Orange Mills Flats, Florida.—By a resolution passed in May, 1898, Congress requested the Secretary of War to furnish information as to the condition of this locality with reference to navigation for ocean-going craft, and to submit an estimate of the cost of such improvement as might be necessary.

In response to this resolution a report was submitted and is printed on pages 1344 to 1348, Annual Report of the Chief of Engineers for 1898. This report contemplates the formation of a channel 200 feet wide and 13 feet deep at mean low water through the shoals between Jacksonville and Palatka, Fla., at an estimated cost of $120,000.

The river and harbor act approved March 3, 1899, adopted this project and appropriated the sum of $40,000 for carrying it into effect.

A survey from Tocoi Point to Cow Creek was made July 10 to August 17, 1899. This embraced the four shoals in the stretch between Jacksonville and Palatka. It was found that the ruling depths on these shoals were: Forresters Point Shoal, 11.6 feet; Orange Mills Flats Shoal, 9.8 feet; Racey Point Shoal, 10.7 feet; and Tocoi Point Shoal, 11.1 feet.

After the survey was completed a project was adopted for the expenditure of the balance of available funds in dredging a channel 200 feet wide and 13 feet deep through Orange Mills Flats proper. A contract for this work was entered into November 14, 1899, under which it is proposed to remove about 330,000 cubic yards of material. Work was commenced under this contract on April 2, 1900, and was in progress at the close of the fiscal year.

A channel 13 feet deep has been dredged over a length of 9,851.2 feet, 836.2 feet of this being 120 feet wide, 8,671.2 feet being 80 feet wide, and 343.8 feet being 40 feet wide. This cut when completed will have a length of about 12,360 feet.

July 1, 1899, balance unexpended		$40, 000. 00
June 30, 1900, amount expended during fiscal year		12, 650. 25
July 1, 1900, balance unexpended		27, 349. 75
July 1, 1900, outstanding liabilities	$7, 150. 88	
July 1, 1900, amount covered by uncompleted contracts	17, 538. 67	
		24, 689. 55
July 1, 1900, balance available		2, 660. 20

Amount (estimated) required for completion of existing project	80, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	40, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 2.)

3. Volusia Bar, Florida.—The bar is located at the south end, or head, of Lake George, St. Johns River, about 162 miles from the mouth.

An examination of the locality with a view to improvement was made in 1879, and a plan was presented which contemplated the construction of two jetties carried out beyond the bar, with their outer ends from 200 to 250 feet apart, with a view of obtaining a depth of 6 feet at low water over the bar.

Before any improvement was commenced the channel over the bar was very crooked and had a least depth varying from 3½ to 4½ feet.

The plan above presented was modified more or less in succeeding years, still maintaining the jetties, and dredging if necessary to assist in gaining the depth.

In 1887 this project was modified so as to limit the depth to 5 feet, already attained, which was deemed sufficient for the steamers navigating the Upper St. Johns River.

With the appropriations made since the inception of the project two jetties have been built, starting from opposite sides of the river bank at the south edge of the lake and converging until upon the bar they are 230 feet apart. The east jetty is 3,400 feet long and the west jetty 2,200 feet. They are built to the level of mean low water throughout nearly their entire lengths. Two rows of firmly set piles provided with waling pieces confine boats to a 100-foot channel across the crest of the bar. Two hundred and fifty-eight cubic yards of material was dredged and the fender piles were repaired in November, 1893.

With the money made available for this work by the two appropriations of $1,000 each made by the acts of August 18, 1894, and June 3, 1896, respectively, dredging to the extent of 4,242 cubic yards was done by contract in September and October, 1896. This resulted in a channel through the shoal near the ends of the jetties, having a least width of 80 feet.

The amount expended to June 30, 1899, was $29,322.45.

The maximum draft that can be carried through the improved channel at low water is 5 feet. The work done during this fiscal year consisted only of repairs necessary for maintenance of the improvement.

An appropriation of $2,000 is required each year for maintenance. With this sum piling will be renewed and such dredging done as may be necessary for maintaining a low-water depth of 5 feet.

July 1, 1899, balance unexpended	$1,677.55
June 30, 1900, amount expended during fiscal year	1,677.55
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix Q 3.)

4. Ocklawaha River, Florida.—The Ocklawaha River has its source in Lake Apopka, central Florida, flows slightly west of north for about 104 miles, measured along the axis of the channel, then almost due east for 21 miles farther, when it unites with the St. Johns River. The Ocklawaha River is the principal outlet of a number of large lakes, the aggregate area of which is about 175 square miles.

From Lake Griffin down for a distance of about 28 miles the river flows through a wide savanna submerged about 1 foot under water and covered with a dense growth of saw grass. On this reach the river averages from 30 to 40 feet in width and has a least channel depth of about 5 feet; the current is very sluggish.

The impediments to navigation on this portion of the river are the numerous bends, the narrow channel, floating islands, and eelgrass. From the savanna to the mouth, a distance of about 58 miles, the banks are covered with a dense growth of cypress and other timber. On this reach the river averages from 60 to 70 feet in width, and the least channel depth is 4 feet. The average velocity of the current is considerably greater than on the upper river, being about 1.3 feet per second. The principal obstructions to navigation here are snags and overhanging trees.

The project for the improvement of this river consists in removing snags, overhanging trees, floating islands, and other obstructions of like character, so as to give a fair navigable channel of 4 feet depth from the mouth to Leesburg, at the head of Lake Griffin, a distance of 94 miles. The estimated cost of this work is $26,000.

The amount expended on this improvement, up to June 30, 1899, was $18,366.30. This was for the removal of overhanging trees and snags. The river had been placed in a fairly navigable condition for a distance of about 60 miles from its mouth.

During the cessation of work many trees, logs, and snags became obstructions to navigation. With funds appropriated by the river and harbor acts of June 3, 1896, and March 3, 1899, work was resumed on March 11 and continued until May 31, 1899. The U. S. snag boat *Suwanee* was used for this work, and all that portion of the river between the mouth and Silver Springs Run, a distance of 53 miles, was thoroughly cleared of obstructions to navigation.

The maximum draft that can be carried at low water is 4 feet.

The improvement of this river has had no effect on commercial interests, except to render navigation more safe.

July 1, 1899, balance unexpended	$1,633.70
June 30, 1900, amounted expended during fiscal year	1,633.70
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix Q 4.)

5. *St. Augustine Harbor, Florida.*—The approved project is to protect the shores on the north and south sides of the entrance from erosion, the work consisting of groins constructed of riprap on brush foundation and capped with concrete.

Work was begun in 1889. Seven groins in all have been built, three on the north beach and four on Anastasia Island on the south side of the entrance. Their lengths vary from 220 to 549 feet.

The erosion of the shore line has, with slight exceptions, been stopped. The outer portion of the north beach has been built out to the extremities of the groins.

The appropriation made in act of August 18, 1894, has not been expended, as there has seemed to be no immediate necessity for further work to protect the beach. The amount available is reserved for emergencies that may arise as the result of storms or a sudden wearing away of the shore line.

The amount expended up to June 30, 1899, was $64,999.90.

This improvement, being confined to the protection of the outer shore lines of the entrance, has had no effect whatever on the character and amount of commerce, which is practically nothing as far as water transportation is concerned.

The maximum draft that can be carried over the bar at mean low water varies from 6 to 9 feet.

July 1, 1899, balance unexpended	$6,000.10
July 1, 1900, balance unexpended	6,000.10
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	24,000.00

(See Appendix Q 5.)

6. *Indian River, Florida.*—Operations under separate projects and appropriations have been carried on at three localities on the river, viz, the portion of the river proper between Goat Creek and Jupiter Inlet, Negro Cut and Indian River Inlet, and Jupiter Inlet.

Between Goat Creek and Jupiter Inlet.—Under the provisions of the river and harbor act of 1890 a survey of this portion of Indian River was made and a project adopted which contemplated making a continuous channel 5 feet deep at low water and at least 75 feet wide in the straight reaches, with as much greater width in the turns as may be required, at an estimated cost of $44,000.

The Florida Coast Line Canal and Transportation Company possessed a franchise granted by the State of Florida which included this portion of the river and had dredged a continuous navigable channel along it 50 feet wide and 5 feet deep. After considerable delay the canal company made the necessary relinquishment of the rights they possessed under their franchise, and work under the appropriation of July 13, 1892, was commenced by the U. S. hydraulic dredge *Suwanee* July 28, 1895. The channel previously dredged by the Florida Coast Line Canal and Transportation Company was widened at Long Canal, High Bank Canal, Curved Canal, and Conch Bar by dredging a cut 50 feet wide and 6 feet deep along one side. The aggregate length of all the cuts made by the United States was 11,075 feet, and the total amount dredged was 56,665 cubic yards. The amount expended on this part of the river to June 30, 1899, was $15,000.

Negro Cut, Indian River Inlet.—The river and harbor act of August 18, 1894, appropriated $5,000 for dredging at this locality. The urgent deficiency act of March 2, 1895, made a further appropriation of $15,000 for the same work.

A project was adopted contemplating the formation of a channel 100 feet wide and 6 feet deep from the channel of Indian River through Negro Cut to the bar at Indian River Inlet, and the construction of a training wall for its protection, at an estimated cost of $32,775.

The available channel depth before improvement was 1.5 feet.

Dredging was begun with the U. S. dredge *Suwanee* on January 9, 1896, and the channel called for by the project was completed September 26, 1896. A total of 93,583 cubic yards of material was removed.

The river and harbor act of June 3, 1896, appropriated a further sum of $7,500 for dredging this channel. The amounts previously appropriated were sufficient to complete the projected dredging, and subsequent appropriations should have been made available for the construction of the training wall, which is necessary for the protection of the dredged channel, as contemplated in the project. It being desirable to commence the construction of the training wall, the question as to whether this appropriation could be applied to that purpose was submitted to the Comptroller of the Treasury, who decided that it was not permissible without further action by Congress.

The amount expended on improvement at Negro Cut to June 30, 1899, was $19,679.53. No work has been done at this locality since September, 1896, pending action by Congress to make the appropriation of $7,500 of June 3, 1896, available for the construction of the training wall.

The river and harbor act of March 3, 1899, authorized the expenditure of the balance available of former appropriations for the construction of the training wall, and also appropriated a further sum of $5,000 for dredging.

Jupiter Inlet.—By act of Congress approved February 26, 1896, an appropriation of $500 was made to open this inlet for the passage of boats and small vessels. An examination of the inlet was made March 15, 1896. It was found that the inlet was entirely closed by a ridge of sand varying in width from 350 to 800 feet at low water, with a crest at an elevation of 7 to 9 feet above mean low water.

The project adopted contemplated making a cut 40 feet wide on the bottom and 2 feet deep at low water. Work was begun September 5 and was satisfactorily completed September 19, 1896. The total amount expended on this part of Indian River to June 30, 1899, was $500. The project was completed.

The maximum draft that can be carried through Indian River is 5 feet at mean low water.

Water transportation on Indian River was temporarily decreased by the extension of the railroad along the river bank to Miami and by the freeze of 1894–95, which destroyed or set back the growth of nearly all the orange and lemon groves. During the past two years, however, a new line of steamers has been running on the river, doing a large business in freight and passengers. The growers of this section have been able to ship their produce by water as far north as Titusville, and thereby effect a considerable saving on incoming and outgoing freight.

The improvement of the river between Goat Creek and Jupiter Inlet (begun with an appropriation of $15,000 under the estimate of $44,000) is worthy of completion.

INDIAN RIVER, BETWEEN GOAT CREEK AND JUPITER INLET.

Amount (estimated) required for completion of existing project	$29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

NEGRO CUT, INDIAN RIVER INLET.

July 1, 1899, balance unexpended	$12,820.47
June 30, 1900, amount expended during fiscal year	93.87
July 1, 1900, balance unexpended	12,726.60

(See Appendix Q 6.)

7. *Harbor at Key West, Fla., and entrance thereto.*—In 1882 an appropriation of $25,000 was made for dredging a channel through the bar at the northerly entrance, over a width of 300 feet and to a depth of 17 feet at mean low water. As was anticipated, the improvement effected was only temporary.

The project now in course of execution contemplates gaining a depth of 17 feet at low water by the construction of a jetty on the northeast side of the passage or entrance, supplemented by one on the west side and, if necessary, by dredging the bar.

Previous to the inception of this project the surveys showed a channel depth over the bar of 10.5 feet at mean low water.

With the appropriations made prior to that of June 3, 1896, a jetty has been constructed on the northeasterly side of the entrance 11,354 feet in length. Of this, 3,950 feet, measured from the outer end, has been built to the height of mean low water. The remaining portion of the jetty is at an average depth of 4½ feet below mean low water.

With the appropriation of $80,000 made in the act of June 3, 1896, it was decided to begin the construction of the west jetty. In order to determine the best location for this jetty, an extended series of borings to rock was required. The survey was completed in February, 1897.

Operations were begun on the west jetty in December, 1897. To June 30, 1899, 43,396.6 tons of coral rock were placed, completing the foundation and hearting of the west jetty from Station 1300 to Station 5900. On that date there was a safe channel across the bar 10.5 feet deep at mean low water.

The amount expended to June 30, 1899, was $327,207.99.

Under a contract entered into July 15, 1899, work was commenced July 25, 1899, and completed January 11, 1900. A total of 10,503.3 tons of coral rock was placed in the west jetty under this contract, extending the foundation and hearting of the jetty from Station 1300 to Station —552.

The channel over the bar has shoaled to some extent during the year, and where a draft of 10.5 feet could be safely carried through on a straight line last year, not more than 10 feet can be carried through now, and then only with a turn in the course.

An allotment of $5,000 from appropriation contained in the emergency river and harbor act of June 6, 1900, was made June 30, 1900, for dredging.

The estimate presented by the Board appointed to consider the project for this improvement was for the construction of the east jetty and amounted to $500,000, although the Board foresaw the probable necessity for the construction of a west jetty. Authority has been given for the commencement of construction of the west jetty, but no increase in the estimate has as yet been authorized.

The character of the commerce affected by this improvement is somewhat varied and complicated. If the improvement were completed the channel would be used by all steamships plying to the Gulf ports, especially when westward bound. The improvement already effected has given a safe channel over the northwest bar for light-draft steamers at all times.

The commerce of Key West itself has decreased since 1892, owing to the removal of several cigar factories. The amount of freight carried through the northwest channel has, on the other hand, increased 50 per cent. This freight consists of agricultural products, cattle, lumber, sponges, cigars, tobacco, ship stores, and general merchandise.

July 1, 1899, balance unexpended	$25,292.01
June 30, 1900, amount expended during fiscal year	24,900.39
July 1, 1900, balance unexpended	391.62
July 1, 1900, outstanding liabilities	58.60
July 1, 1900, balance available	333.02
Amount (estimated) required for completion of existing project	200,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q 7.)

8. Removing the water hyacinth from Florida waters.—Under the provisions of the sundry civil act approved June 4, 1897, a Board of Engineer Officers was appointed to investigate the extent of the obstruction of the navigable streams of Florida, Louisiana, and other South Atlantic and Gulf States, by the aquatic plant known as the water hyacinth, and to perform such experimental work as might be deemed necessary to determine a feasible plan or method of checking or removing such obstructions.

The report of this Board, dated November 30, 1898, is printed in House Doc. No. 91, Fifty-fifth Congress, third session, and on page 1615 of the Annual Report of the Chief of Engineers for 1899. In Florida the Board found that the main channel of the Upper St. Johns River was affected by the plant, while many of the smaller channels were completely blocked. The Board recommended the construction of a steamer fitted with crushing machinery, and the use of log booms as adjuncts to the operation of the boat.

The river and harbor act approved March 3, 1899, appropriated $25,000 for the construction of a boat, $1,000 for log booms, and $10,000 for operating expenses. Under this provision it is proposed to design a suitable boat and have same built by contract. Some work has been done on plans, but the matter has been deferred pending results of a test of the boat procured for the Louisiana district.

During the winter of 1899–1900 the tops of the plants in the St. Johns River were destroyed by a frost which has retarded their interference with navigation. Recent reports indicate that the plant is becoming troublesome in the Withlacoochee River on the Gulf coast.

July 1, 1899, balance unexpended	$36,000.00
June 30, 1900, amount expended during fiscal year	573.23
July 1, 1900, balance unexpended	35,426.77

(See Appendix Q 8.)

9. Dredge for river and harbor improvements in Florida.—The river and harbor act approved March 3, 1899, contained the following item:

> The sum of thirty-five thousand dollars, or so much thereof as may be necessary, is hereby appropriated, to be expended, in the discretion of the Secretary of War, in the purchase or construction of a suitable dredge, with snagging outfit, to be used in connection with the several works of river and harbor improvement on the coast of Florida and the waters tributary thereto.

Under this provision it is proposed to design a steel hull, stern wheel, combined dredge and snag boat, about 115 feet long, 28 feet beam, and 7 feet depth, to be driven by a 200-horsepower engine, and to be fitted with dredging machinery consisting of a 2-yard clam shell and a 12-inch centrifugal pump; also snagging appliances adapted for use with the dredging machinery. Work of preparation of plans and specifications has been under way during the year.

The original estimate for this boat, as submitted to Congress, was $50,000, but only $35,000 has been appropriated. The inadequacy of this amount was pointed out in letter of the Chief of Engineers of January 25, 1900, transmitted to the Speaker of the House of Representatives and printed in House Doc. No. 356, Fifty-sixth Congress, first session.

July 1, 1899, balance unexpended	$35,000.00
June 30, 1900, amount expended during fiscal year	1,892.48
July 1, 1900, balance unexpended	33,107.52
July 1, 1900, outstanding liabilities	300.00
July 1, 1900, balance available	32,807.52
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q 9.)

REPORT OF BOARD OF ENGINEERS ON EXAMINATION OF BISCAYNE BAY, FLORIDA, FROM MIAMI TO THE SEA, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

A Board of Engineers, constituted in accordance with requirements of the river and harbor act of March 3, 1899, to examine and report upon *Biscayne Bay, Florida, from Miami to the sea, via Norris Cut, Bears Cut, and Capé Florida entrance*, submitted report dated April 9, 1900. The Board concludes that the most feasible route for improvement in the manner contemplated by the act is via Norris Cut, and a plan for improvement, at an estimated cost of $1,493,743, is presented. In the opinion of the Board such an improvement is not a desirable one to be undertaken by the United States at this time. The report was transmitted to Congress and printed in House Doc. No. 662, Fifty-sixth Congress, first session. (See also Appendix Q 10.)

IMPROVEMENT OF RIVERS AND HARBORS ON THE WESTERN COAST OF FLORIDA SOUTH OF AND INCLUDING SUWANEE RIVER.

This district was in the charge of Capt. Henry Jervey, Corps of Engineers, to January 18, 1900, and of Capt. Thomas H. Rees, Corps of Engineers, since that date, the officers in charge having under their immediate orders Lieut. Frank C. Boggs, Corps of Engineers, to June 15, 1900. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. Caloosahatchee River, Florida.—An examination of this river, with a view to its improvement, was made in 1879. In 1887 a survey was made from Lake Okechobee to the mouth.

Before improvements commenced upon this river there was a practicable channel 5 feet deep at mean low water from the mouth to 4 miles above Myers. The portion of the river which has the characteristics of an estuary was principally obstructed by oyster beds. Above, as far as Fort Thompson, the ruling depth was 3½ feet on the shoal at Beautiful Island. This portion was obstructed by snags and overhanging trees.

The project adopted in 1882 called for deepening the channel by dredging from the mouth to Fort Myers, so as to give a depth of 7 feet at mean low water for a width of 100 feet. In 1886 and 1888 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by the removal of snags and overhanging trees, and by deepening the channel near Beautiful Island to a depth of 4 feet.

With the money appropriated from 1882 to 1890 the shoals below Myers were dredged to a depth of 7 feet and the channels across the bars marked with suitable piles. Above Myers the shoal at Beautiful Island was dredged to 4 feet and a dike, or training wall, provided to concentrate the water through the dredged cut. A large number of snags have been removed from this portion of the river.

The appropriations since 1890 have been made for maintenance, and they have been expended in removing such snags and overhanging trees as had become obstructions during the cessation of work, and in repairing the channel marks on the lower portion of the river.

An appropriation of $1,000 annually will be required to keep this river in a fair navigable condition.

The amount expended up to June 30, 1899, was $31,379.27.

During the past fiscal year no work has been done, except some repairs to the snag boat *Suwanee*, in preparation for work at this and other points.

The maximum draft that can be carried at mean low water is 7 feet as far as Myers and 4 feet above that place as far as Fort Thompson, which is about 22 miles west of Lake Okechobee.

The deepening and clearing of the river has enabled the growers of vegetables, oranges, and other fruits to ship their produce to the railroad at Punta Gorda at rates materially less than those that prevailed before the improvement was begun. The freeze of 1894–95 has shifted the fruit and vegetable industries farther south, and the country tapped by the Caloosahatchee River and tributaries now furnishes a large and growing proportion of the Florida output of these commodities.

July 1, 1899, balance unexpended	$2,220.73
June 30, 1900, amount expended during fiscal year	326.63
July 1, 1900, balance unexpended	1,894.10
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix R 1.)

2. *Charlotte Harbor and Peace Creek, Florida.*—Work upon this improvement was commenced under an appropriation of $35,000 made by the river and harbor act of September 19, 1890, for improving, dredging, and deepening the channel of Charlotte Harbor and Peace Creek to the pier at Punta Gorda.

The survey from Boca Grande to Punta Gorda made under this appropriation disclosed a channel depth of 19 feet at mean low water on the bar, 9 feet on the shoals south of Cape Haze, and 10 feet upon the shoals near the wharf at Punta Gorda. The rise of the tide is approximately 2 feet.

The approved project contemplates the improvement of the channel so as to give a depth of 12 feet at mean low water from the wharves at Punta Gorda to Boca Grande over a width of 200 feet. The estimated cost was $127,500, reduced in 1896 to $100,000.

The amount expended up to June 30, 1899, was $75,052.29.

The work accomplished by this expenditure was the removal by dredging of 233,317 cubic yards of material, which has resulted in making a channel 12 feet deep at mean low water from the wharves at Punta Gorda to Boca Grande. This channel was 200 feet wide for the entire distance, except in the cut across the shoals near the wharves, where the minimum width was 35 feet.

The river and harbor act of March 3, 1899, appropriated for this work, completing improvement, $25,000.

During the fiscal year ending June 30, 1900, two contracts have been in force, and under these 125,182 cubic yards of material was removed from the cut across the shoals near the Punta Gorda wharves. This work has resulted in increasing the width of this cut from a minimum of 35 feet to a minimum of 120 feet. The length of the cut last dredged is 5,680 feet, and the depth attained exceeds 12 feet at mean low water. With the exception of expenditures that may be needed for maintenance, and which have been estimated at about $1,000 per annum, this project has been practically completed, and has resulted in providing a channel not less than 120 feet in width and 12 feet in depth at mean low water, extending from the wharves at Punta Gorda to deep water in the Gulf of Mexico. In accomplishing this result there was dredged a total of 358,499 cubic yards of material at a total cost of $99,934.42.

The commerce of Charlotte Harbor has increased rapidly since 1891, most of the increase being due to the development of phosphate mines on Peace Creek. It consists of receipts and shipments of cattle, fertilizers, grain, fruits, vegetables, lumber, fish, and oysters, phosphate rock, and general merchandise.

July 1, 1899, balance unexpended	$24,947.71
June 30, 1900, amount expended during fiscal year	24,882.13
July 1, 1900, balance unexpended	65.58
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix R 2.)

3. Sarasota Bay, Florida.—Previous to any attempt at improvement there was a navigable channel with a minimum depth of 5 feet extending throughout the length of Big Sarasota Bay, excepting in two reaches, Palma Sola Pass and Long Bar, which have a total length of 5,400 feet. In these reaches the available depth was 4.3 and 3.5 feet, respectively. The tidal range in the bay is about 1.5 feet.

Between Sarasota and Caseys Pass, at the south end of the bay, the available channel depth was 1.2 feet at mean low water, except through the Mangroves, where it was nothing.

The original project contemplated the formation of a continuous channel 100 feet wide and 5 feet deep at mean low water from Tampa Bay to the town of Sarasota, Fla., a distance of 21¼ miles, the estimated cost being $17,500.

The act of Congress of June 3, 1896, appropriated $2,500 for improving Sarasota Bay from Tampa Bay to Caseys Pass, while previous to that date the improvement was only for Sarasota Bay from Tampa Bay to Sarasota, Fla. The survey of 1889 was made, as directed, from Tampa Bay to Caseys Pass, and an estimate was presented amounting to $37,500 for securing a channel 75 feet wide and 3 feet deep at mean low water through the obstructing shoals below Sarasota. Under the act of June 3, 1896, the latter project is included in the improvement, so that the total estimate of cost for the modified project is now $55,000. The amount expended to June 30, 1899, was $11,989.83, and the work accomplished up to that date resulted in the formation of a channel 50 feet wide and 5 feet deep from Tampa Bay to the town of Sarasota. A channel 50 feet wide with an available depth of 3 feet has been cut for a distance of 1,460 feet into the Mangroves. No practical result will be obtained from the latter work until the remainder of the cut, 1,573 feet long, is made there. Below the Mangroves there is 10,067 feet of channel to be dredged to 3 feet, in which the available depth is now 1.2 feet. The maximum draft that can be carried at low water to the town of Sarasota is 5 feet. Caseys Pass can not yet be reached from northward by inside passage. The improvement of Sarasota Bay has resulted in cheapening the cost of transportation between Sarasota and points northward.

No operations have been carried on during the past fiscal year. The expenditures were for office expenses and for repairing the plant, which is to be used at this point as soon as it can be spared from work upon which it has been employed. The commerce in vegetables, fruits, and cattle is growing. All trade is conducted by water transportation, and the improvement of the channels affords a safe route for small vessels in any weather.

July 1, 1899, balance unexpended	$5,510.17
June 30, 1900, amount expended during fiscal year	1,216.39
July 1, 1900, balance unexpended	4,293.78
Amount (estimated) required for completion of existing project	37,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	37,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix R 3.)

4. *Manatee River, Florida.*—For 12 miles from its mouth in Tampa Bay this river has the characteristics of an estuary. Previous to

improvement in the estuary the general depth of the river varied from 7 to 20 feet. At the mouth there was a long shoal with a depth of 7 feet. Between Palmetto and Braidentown there was another bar covered by from 3 to 5 feet of water.

An examination of the river with a view to its improvement was made in 1881, and a project adopted in 1882 which contemplated forming a channel 100 feet wide and 13 feet deep from Tampa Bay to Shaw and McNeills points.

In 1886 the project was modified so as to provide a channel 100 feet wide and 8 feet deep at mean low water from Tampa Bay to Manatee, Fla.

This channel was completed, and in 1892 the original project was again adopted. The revised estimate for this work is $73,000.

Under the terms of the river and harbor act of June 3, 1896, which provided that $3,000, or so much thereof as necessary, of the funds appropriated for improving this river should be used in improving the cut-off into Terraceia Bay, a project for making a channel through the cut-off 100 feet wide and 6 feet deep was submitted, and approved on June 23, 1897. It was estimated that this channel would cost $20,000. Previous to improvement there was a channel through this cut-off, for rowboats only, of 1 foot at mean low water.

The amount expended to June 30, 1899, was $46,898.49, including $3,000 for the cut-off into Terraceia Bay.

In 1883–84 a cut was made to a depth of 12.5 feet across the bar at the mouth of the river. This cut has since entirely disappeared. During and prior to 1890 a channel 150 feet wide and 8 feet deep was dredged through the shoal between Manatee and Braidentown. In 1893 a channel was dredged through the shoal at Sneads Point 81 feet wide and 12 feet deep; and in 1896 this channel was extended and widened, so that it is now 100 feet wide and 12 feet deep.

In 1897, August to October, a channel was cut through the cut-off into Terraceia Bay 50 feet wide, 4.5 feet deep, and 2,840 feet long. This channel allowed small craft to pass to and from Manatee River and Terraceia Bay, but it was not wide and deep enough to permit the passage of some steamers which ply regularly between Tampa and the Manatee River.

During the past fiscal year operations have been confined to the cut-off from Manatee River to Terraceia Bay. A total of 53,231.6 cubic yards of sand and hardpan was dredged from the cut between September 14, 1899, and April 25, 1900, at an average cost of 18.3 cents per cubic yard. The cut is practically completed, but there will be required about $500 annually for its maintenance.

The present condition of the river is such (June 30, 1900) that a least depth at mean low water of 9 feet can be obtained from Tampa Bay up the river to Braidentown, 8 feet to Ellenton, and 7 feet to Rocky Bluff, which is about 11 miles from the bay.

A draft of 6 feet can be carried through Terraceia Cut-off.

The commerce of the locality consists of agricultural products, fertilizers, lumber, and general merchandise.

The increase in tonnage due to improvement of this stream for several years past is shown by the following statement:

	Tons.		Tons.
1893	6,872	1897	23,800
1894	11,552	1898	24,310
1895	11,718	1899	43,542
1896	21,000		

July 1, 1899, balance unexpended	$10,101.51
June 30, 1900, amount expended during fiscal year	10,028.29
July 1, 1900, balance unexpended	73.22
Amount (estimated) required for completion of existing project	27,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix R 4.)

5. *Tampa Bay, Florida.*—Tampa Bay is a large landlocked body of water, on the west coast of Florida, with an average width of from 6 to 7 miles, and a length, exclusive of its two tributary bays, of about 25 miles, in a general northeast and southwest direction. Its two tributary bays are Old Tampa Bay, entering at the northwestern end, and Hillsboro Bay, entering at the northeastern end.

Across the bar at the entrance and up to the point of division the channel has a depth of from 20 to 38 feet at mean low water. Old Tampa Bay is about 15 miles long, with an average width of 6 miles. Its narrowest point is where it joins Tampa Bay, where its width is a little less than 2½ miles. This bay is generally shallow, but at the southern end has several deep channels. One of these leads along the eastern shore at a distance of about three-fourths mile from the beach and forms the approach to and harbor of Port Tampa. Between deep water in Tampa Bay and the deep channel in Old Tampa Bay are two bars, upon which the depth in 1889 was only 17 feet.

Tampa Bay is the approach to the city of Tampa and to Port Tampa, the former at the head of Hillsboro Bay and the latter on the eastern shore of old Tampa Bay. Port Tampa is about 9 miles from Tampa, with which it is connected by railway and of which it is the deep-water port.

Prior to the act of March 3, 1899, all approved projects for the improvement of Tampa Bay included the formation of a channel from the city of Tampa through Hillsboro Bay. The original project, adopted in 1879, had such a channel for its sole object. This project is given in the report on Hillsboro Bay (see page 323 of this report). It was modified in 1888 to fit new conditions. Port Tampa had become the terminus of a railroad which there made connection with steamship lines for Key West, Habana, Mobile, and Central American ports. The modified project proposed to form and maintain a channel 8 feet deep in Hillsboro Bay and Hillsboro River to the city of Tampa and a channel 20 feet deep and 200 feet wide from the outer bar to Port Tampa.

From 1880 to 1892 Congress appropriated for the improvement of Tampa Bay $130,000, being all the funds required by the original and modified projects. Of this amount $80,000 was expended on the channel in Hillsboro River and Hillsboro Bay and the balance in dredging on the bars at the mouth of Old Tampa Bay.

The Port Tampa channel was completed May 12, 1892, in accordance with the project of 1888, by the expenditure of $50,000.

The total amount expended on this improvement to June 30, 1899, is $50,737.19. On that date the available depth at mean low water from the entrance of Tampa Bay to Port Tampa was 20 feet. At high tide 22 feet can be carried over the bar at the entrance, and ships have been loaded at Port Tampa to a draft of 21½ feet on spring tides. The present project was inaugurated by Congress under the act of March 3, 1899, in item of appropriation, as follows:

> Improving Tampa Bay, Florida: For improvement of Tampa Bay, Florida, from its entrance into the Gulf of Mexico to Port Tampa, seventy-five thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary toward securing a channel depth of twenty-seven feet from said Gulf of Mexico to Port Tampa, and of a width of five hundred feet across the bar and three hundred feet in the bay, as proposed in the report of November fourteenth, eighteen hundred and ninety-eight, published in House Document Number Fifty-two, Fifty-fifth Congress, third session, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate six hundred and seventy-five thousand dollars, exclusive of the amount herein appropriated.

Bids were opened for this work on June 29, 1899. It is proposed under the specifications to secure, first a 24-foot depth throughout the channel in order to benefit commerce as quickly as possible, and afterwards to increase this depth to 27 feet. The lowest bid received was 15 cents per cubic yard for dredging on the bar and 11.99 cents for dredging in the bay. At these prices a contract for the work was entered into August 5, 1899, by the terms of which it was required that $65,000 be earned by June 30, 1900, and that 1,000,000 cubic yards be removed during each succeeding year, provided funds are available, till completion.

Work was begun at the Narrows August 3, 1899, and from that date to June 30, 1900, there was removed from the channel in accordance with the approved project a total of 295,715.8 cubic yards of material. This was taken from the two sections of the channel at the Narrows and from one of the two shoals near Port Tampa, and has resulted in an average increase of depth in the sections worked over of from 1.3 to 2.2 feet. The available depth throughout the channel has not been increased, since some shoals have not yet been touched.

The appropriation of June 6, 1900, will be expended during the coming fiscal year in continuing the work in accordance with the approved project.

COMMERCIAL STATISTICS.

	Tons.
Phosphate rock:	
1891	15,482
1892	65,406
1893	98,637
1896	197,413
1897	165,606
1898	169,916
1899	201,403
Total commerce, including phosphate rock:	
1896	276,638
1898	236,156
1899	238,305

July 1, 1899, balance unexpended		$74,262.81
Amount appropriated by sundry civil act approved June 6, 1900		135,000.00
		209,262.81
June 30, 1900, amount expended during fiscal year		32,668.68
July 1, 1900, balance unexpended		176,594.13
July 1, 1900, outstanding liabilities	$3,276.16	
July 1, 1900, amount covered by uncompleted contracts	661,341.18	
		664,617.34
Amount (estimated) required for completion of existing project		540,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		137,000.00
Submitted in compliance with requirements of sections 2 or river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix R 5.)

6. *Hillsboro Bay, Florida.*—Hillsboro Bay is the northeastern arm of Tampa Bay. It is about 10 miles long in a general north and south direction, and has an average width of about 4½ miles. The city of Tampa is located at the head of this bay at the mouth of the Hillsboro River. It is separated from the 12-foot depth in the bay by a flat about 3 miles wide. Originally there existed through this flat a narrow channel, with an average available depth of about 5 feet, formed by the waters of Hillsboro River.

The original project was adopted in 1879, and had for its object the formation of a 9-foot channel, 150 feet wide in the bay and 200 feet wide in the river, fróm the 9-foot curve in the bay to the wharves at Tampa in the Hillsboro River. Nearly $70,000 was expended under this project. In 1888 the project was modified to provide for the formation and maintenance of a channel 8 feet deep in Hillsboro Bay and Hillsboro River to the city of Tampa, and a channel 20 feet deep and 200 feet wide from the outer bar to Port Tampa.

Between 1880 and 1892 Congress appropriated $130,000 for the improvement of Tampa Bay, being all the funds required for the original and modified project. Of this amount an aggregate of $80,000 was expended on the channel in Hillsboro Bay and Hillsboro River.

Work on the Hillsboro Bay channel was stopped June 3, 1893. The total amount expended on this improvement to June 30, 1899, was $80,652.39. At that date the channel at the mouth of the river was about 200 feet wide and 9 feet deep, but in the channel below there were places where the depth was only 7 feet and the width less than 80 feet.

The present project, inaugurated by Congress under the act of March 3, 1899, contemplates the formation of a channel in Hillsboro River, from a point about 100 feet south of the bridge crossing the river at Lafayette street to the mouth of the river, and from there along the line of shortest distance to the 12-foot contour in Hillsboro Bay; this channel is to be 12 feet deep at mean low water, 200 feet wide in the river, and 150 feet wide in the bay. The estimated cost of the proposed work is $300,000 with $1,000 annually for maintenance.

The act of March 3, 1899, appropriated $125,000 for this improvement.

A contract dated September 19, 1899, was entered into for dredging at 19.75 cents per cubic yard and removal of rock at $4.90 per cubic yard, this being the lowest bid. Work began December 6, 1899, and from that date to June 30, 1900, there was removed from the new channel, in accordance with the approved project, 201,037.73 cubic yards of dredged material. The result of this work is a cut about 12 feet deep at mean low water, 60 feet wide at the bottom, and 9,180 feet in aggregate length, with side slopes of 1 on 3. This channel is not yet available for shipping, as there remains a shoal about 4,385 feet long to be cut through. The old channel is therefore still used under practically the same conditions as obtained a year ago.

The estimate for the fiscal year 1902 will, if appropriated, be applied to completion of the project.

The commerce of Hillsboro Bay for the year ending December 31, 1898, amounted to 32,070 tons; for the year ending December 31, 1899, it was 110,240 tons. Statistics for previous years are not available.

July 1, 1899, balance unexpended		$124,347.61
June 30, 1900, amount expended during fiscal year		30,301.23
July 1, 1900, balance unexpended		94,046.38
July 1, 1900, outstanding liabilities	$5,104.40	
July 1, 1900, amount covered by uncompleted contracts	51,892.03	
		54,996.43
July 1, 1900, balance available		39,049.95

Amount (estimated) required for completion of existing project	175,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	175,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of June 4, 1897.	

(See Appendix R 6.)

7. *Anclote River, Florida.*—For a general description of this locality reference is made to Annual Reports of the Chief of Engineers for 1895, pages 1573–1576, and for 1898, pages 1361–1363.

Initial work was begun on this improvement by the U. S. dredge *Suwanee* on May 23, 1900, and from that date to June 30, 1900, there was removed from the channel a total of 11,986.8 cubic yards of material, resulting in a dredged cut 2,900 feet long, 50 feet wide, and 7 feet deep. The increase in depth varies, depending on original depths from 0 to 4.8 feet. The available depth to the harbor has not been increased because the cut has not yet been carried through.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	1,884.37
July 1, 1900, balance unexpended	3,115.63
July 1, 1900, outstanding liabilities	700.00
July 1, 1900, balance available	2,415.63

Amount (estimated) required for completion of existing project	46,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R 7.)

8. *Withlacoochee River, Florida.*—The project for the improvement of this river calls for the removal of snags, loose rocks, overhanging trees, and the deepening of some of the prominent shoals and a bar at the mouth, so as to form a channel having an available depth of 2 feet during about half the year from the mouth of the river in the Gulf of

Mexico to Pembertons Ferry, a distance of 77 miles. The project was practically completed November 14, 1892.

The amount expended to June 30, 1899, was $23,914.88.

The improvement has not resulted in any marked benefit to commerce because the period during which navigation is open does not correspond with the season when it is necessary to move the horticultural products of the region.

Large deposits of phosphate have been discovered along the river since the original project for improvement was inaugurated, and the sole means of transporting the mining output is by railroad. The cost of this transportation to the nearest seaport amounts to about one-half the value of the phosphate when delivered aboard ship.

A survey of the river was completed in May, 1897, and report thereon, with plans and estimates for a new project, was printed in the Annual Report of the Chief of Engineers for 1898, pages 1363–1369.

No work was done during the fiscal year ending June 30, 1899, and none is contemplated for the next fiscal year.

The maximum draft that can be carried to the head of navigation in the river is 2 feet.

Under plans that received the approval of the Secretary of War April 21, 1894, and subject to inspection by the district engineer officer, the Dunnellon Phosphate Company is engaged in deepening the channel in order that the products of the mines may be lightered to vessels in the outer anchorage.

July 1, 1899, balance unexpended	$785.12
July 1, 1900, balance unexpended	785.12
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix R 8.)

9. *Suwanee River, Florida.*—The project for the improvement of the Suwanee River was adopted in 1879. The reach of the river covered by the project extended from its mouth in the Gulf of Mexico to Ellaville, a distance of 135 miles. At that time the obstructions in this portion of the river consisted of shoals composed of soft, unstratified limestone mixed with flint, extending partly or entirely across the river, in some instances covered with shallow deposits of sand and in others bare; also snags and overhanging trees. The channels across these shoals were often narrow and very crooked. Their depth at mean low water would vary from 15 inches to 3 feet. At places large isolated limestone bowlders in the channel were imminent sources of danger to navigation.

An examination of the river with a view to its improvement was made in 1879. The estimated cost of the work to be done was $55,158.

The proposed improvement consists in deepening the bar at the passes by dredging, the removal of snags and overhanging trees along the river, and deepening and improving the channel at various places by the removal of rocks and snags and construction of wing dams, so as to straighten, widen, and deepen the channel. The depth to be obtained is 5 feet through the bars at the passes for a width of 150 feet and up the river as far as Rollands Bluff (Branford), a distance of 75 miles. From there to Ellaville, a distance of 60 miles, the depth is to be 4 feet and the width 60 feet. The amount expended to June 30, 1899, was $49,925.05.

The aggregate amount of the appropriations for this work is $55,000. Of this sum, $10,000 was authorized to be expended in the purchase or construction of a snag boat, with dredging and other machinery.

With that amount a boat was built, and it was placed in commission in 1889, since which time it has been in almost constant service on the rivers and harbors in Florida. While it has served its purpose admirably, considering its low cost and the hard duty it has performed, it is now old and is expensive to keep in repair.

The maximum draft that can be carried at low water is 5 feet from the Gulf to Branford and 3 feet from there to Hudson, 10 miles below Ellaville.

No work was done during the fiscal year ending June 30, 1900, except some repairs to the snag boat *Suwanee* in preparation for work on this and other improvements. The balance of the sum of $5,000 appropriated by the river and harbor act of March 3, 1899, will be expended in removing such shoals as may have formed in the dredged channel at the river entrance and at Derricks Gap and the rock shoals above Branford.

The improvement of the river has resulted in a steady increase of its commerce. The percentage of freight carried by river is increasing.

July 1, 1899, balance unexpended	$5,074.95
June 30, 1900, amount expended during fiscal year	1,033.13
July 1, 1900, balance unexpended	4,041.82
Amount (estimated) required for completion of existing project	10,158.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	5,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R 9.)

10. *Removing sunken vessels or craft obstructing or endangering navigation.*—The work accomplished under this appropriation in this district has been confined to the removal of one wreck during the fiscal year ending June 30, 1900. The wreck removed was that of the schooner *Henry Stanbery*, which had foundered in Tampa Bay during a storm on July 15, 1898, and had been reported as a menace to safe navigation. The work was done under contract and was satisfactorily completed January 6, 1900. The total cost of the work was $716.41.

(See Appendix R 10.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineers, Capt. Henry Jervey and Capt. Thomas H. Rees, Corps of Engineers, and reports thereon submitted:

1. *Preliminary examination and survey of Orange River, Florida, to its confluence with the Caloosahatchee and thence to the Gulf.*—Captain Jervey submitted reports dated May 15, 1899, and January 6, 1900,

respectively, with project for improvement at an estimated cost of $2,500 and $500 annually for maintenance. The reports were transmitted to Congress and printed in House Doc. No. 318, Fifty-sixth Congress, first session. (See also Appendix R 11.)

2. *Preliminary examination and survey of inside passage from Puntarasa to Charlotte Harbor, Florida.*—Captain Jervey submitted reports dated May 23 and December 16, 1899, respectively, with plan for improvement at an estimated cost of $6,000. It is his opinion, concurred in by the Division Engineer, Col. Peter C. Hains, Corps of Engineers, that the locality is worthy of improvement by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 286, Fifty-sixth Congress, first session. (See also Appendix R 12.)

3. *Preliminary examination and plan and estimate for improvement of Boca Grande and Charlotte Harbor, Florida.*—Captain Jervey submitted report dated September 5, 1899, with plan for improvement at an estimated cost of $140,000 and $1,000 annually for maintenance. The report was transmitted to Congress and printed in House Doc. No. 76, Fifty-sixth Congress, first session. (See also Appendix R 13.)

4. *Preliminary examination and survey of inside passage through Sarasota Bay to Lemon Bay, Florida.*—Captain Jervey submitted reports dated August 29, 1899, and January 18, 1900, respectively. Two plans for improvement are presented, estimated to cost $41,000 and $27,000, respectively, and $1,000 annually for maintenance; but Captain Jervey states that the extent and value of the existing commerce do not justify an improvement as costly as that proposed and that, in his opinion, an improvement of less extent would not materially benefit the commerce involved. The reports were transmitted to Congress and printed in House Doc. No. 377, Fifty-sixth Congress, first session. (See also Appendix R 14.)

5. *Preliminary examination and survey of the bay at Hudson, Pasco County, Fla.*—Captain Jervey submitted reports dated June 23 and December 26, 1899, respectively. A plan for improvement at an estimated cost of $200,000 is presented; but Captain Jervey is of opinion that the proposed improvement is not justified at the present time. In forwarding the report on preliminary examination the division engineer stated that in his opinion the locality is not worthy of improvement by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 297, Fifty-sixth Congress, first session. (See also Appendix R 15.)

6. *Preliminary examination and survey of Crystal River, Florida, from the town of Crystal River to its entrance in the Gulf.*—Report on preliminary examination was submitted July 29, 1899, by Captain Jervey, and report on survey by his successor, Captain Rees, under date of January 27, 1900. Three plans for improvement, estimated to cost $84,647.46, $77,929.47, and $54,190.75, respectively, are presented, the first plan being preferred. In the opinion of Captain Rees the locality is worthy of improvement to the extent and in the manner proposed. The reports were transmitted to Congress and printed in House Doc. No. 386, Fifty-sixth Congress, first session. (See also Appendix R 16.)

Captain Rees was also charged with the duty of making a preliminary examination and survey of *Kissimmee River, Florida, and connecting lakes and canals flowing into Lake Okechobee, thence down* *the Caloosahatchee River to the Gulf of Mexico, with a view to improving the navigation of the channels therein*, required by the river and harbor act of March 3, 1899, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN GEORGIA AND FLORIDA AND IN EASTERN ALABAMA.

This district was in the charge of Capt. C. A. F. Flagler, Corps of Engineers, having under his immediate orders Lieut. Lewis H. Rand, Corps of Engineers. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. *Carrabelle Bar and Harbor, Florida.*—Carrabelle is situated on the Gulf coast of Florida, about 20 miles east of Apalachicola, at the mouth of Carrabelle River, which constitutes the inner harbor and has a channel along the water front varying in depth from 9 to 15 feet, with a width of 100 feet.

A bar 1 mile wide between the 10-foot contours, having a depth at low tide of from 3 to 4 feet, obstructs the entrance from the river into St. George Sound.

The river and harbor act of June 3, 1896, adopted a project for improvement and appropriated $10,000 to be used in making a 10-foot channel by dredging from the mouth of Carrabelle River to the channel in the bay.

No estimate of the cost of this improvement had been submitted.

Under a contract dated June 11, 1897, a cut was made through the bar separating Carrabelle River from St. George Sound. This cut was 1,050 feet long, 53 feet wide, and 10 feet deep. The work was finished on August 7, 1897.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $10,000.

The river and harbor act of March 3, 1899, appropriated $10,000, under which a project was submitted and approved for continuing the dredging on this bar from the mouth of the Carrabelle River to the channel in the bay.

Under a contract dated January 8, 1900, the work of dredging through the cut made in 1897 was continued, and when the dredging was stopped in May, 1900, for want of funds the channel had been dredged to a depth of 8 feet and a width of 80 feet throughout its entire length.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the channel under improvement was 8 feet.

The commerce of the port of Carrabelle, Fla., consists principally of timber, naval stores, dressed and kiln-dried lumber, shingles, and miscellaneous articles. The value of exports during the fiscal year, foreign and coastwise, was returned at $260,809, while the value of the business interested in procuring deep-water navigation to the water front of the town of Carrabelle is estimated to be about $2,373,600. A greater portion, if not all, of the products of the surrounding country that now finds an outlet by the deep-water harbors on the Atlantic coast would naturally seek the nearer home port of shipment were deep water brought to the water front at the mouth of the Carrabelle River.

July 1, 1899, balance unexpended	$10,000.00
June 30, 1900, amount expended during fiscal year	9,521.28
July 1, 1900, balance unexpended	478.72
July 1, 1900, outstanding liabilities	5.50
July 1, 1900, balance available	473.22
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	24,900.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S 1.)

2. *Apalachicola Bay, Florida.*—The depth of water on the bar at the mouth of the Apalachicola River when the first survey was made, in 1878, was 3.5 feet. The width of the bar between the 8-foot curves varied. Its average width was 7,000 feet. It was therefore unavailable for the purposes of commerce.

The project for improvement adopted in 1879 provided for a channel 100 feet wide and 11 feet deep through the bar at the mouth of the river, the width to be increased to 200 feet if the results of this cut warranted its enlargement. The cost was estimated at $100,000..

This project was amended in 1891 to include a channel 100 feet wide and 9 feet deep through the Bulkhead Shoals.

By act of June 3, 1896, a survey was made of the western part of Apalachicola Bay, from the results of which a new project was made (Annual Report of the Chief of Engineers for 1897, pp. 1655–1659). This project provided for a channel 18 feet deep at mean low water through the West Pass, along the northern shore of St. George Island, and across the bay to the water front of Apalachicola, estimated to cost $350,000 and $20,000 or $30,000 annually for maintenance of completed work. This project was approved by the Secretary of War on June 13, 1899, work to be done under an appropriation of $20,000, made by act of March 3, 1899.

The amount expended on this improvement, including the cost of channel dug through the Bulkhead Shoals, up to the close of the fiscal year ending June 30, 1899, was $153,724.50.

The channel over the bar at the mouth of the Apalachicola River has been gradually shoaling since the dredging done in 1897, and at the close of the fiscal year 1899 had an available depth of 7 feet at mean low water.

During the year ending June 30, 1899, no work was done, the depth and width of the channel remaining about the same as at the close of the fiscal year 1898.

Under an appropriation of $20,000, made by the act of March 3, 1899, a contract was made on December 16, 1899, for digging a channel 18 feet deep at mean low water through the West Pass entrance and the Link Channel, along the north shore of St. George Island, to St. George anchorage. On May 12, 1900, this work was suspended, owing to an exhaustion of the appropriation; the dredging done resulted in obtaining a channel 17 feet deep, 150 feet wide, and 5,280 feet long over the bar at West Pass entrance. No work was done on the Link Channel.

The maximum draft that could be carried June 30, 1900, over the shoalest part of the channel, through West Pass lately improved, was

17 feet at mean low water. Advantage was taken at once of the opening of this pass for the uses of commerce, vessels loading from Apalachicola by lying in the St. George anchorage.

The commerce of this port consists of timber, cotton, naval stores, staves, a large quantity of dressed and kiln-dried lumber, shingles, laths, and miscellaneous freights. The value of these exports, foreign and domestic, is returned at $461,700, while the entire business of the port is estimated at $1,562,000, being an increase of about 25 per cent over the year 1899.

July 1, 1899, balance unexpended	$20,275.50
June 30, 1900, amount expended during fiscal year	19,704.49
July 1, 1900, balance unexpended	571.01
July 1, 1900, outstanding liabilities	45.81
July 1, 1900, balance available	525.20
Amount (estimated) required for completion of existing project	330,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	41,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix S 2.)

3. *Apalachicola River, the Cut-off, and lower Chipola River, Florida.*—The Apalachicola River from the junction of the Chattahoochee and Flint rivers was 6 feet deep at low water throughout its entire length, its width 150 to 300 yards, and when not obstructed by snags and logs brought in by its tributaries was well adapted for all the purposes of the commerce using the stream.

The original project, submitted in 1873, was to widen and straighten Moccasin Slough, a very narrow and crooked cut-off made through to the river Styx, caused by obstructions placed in the main river by the Confederate authorities during the civil war, and provided for the removal of all snags from the river, to give a channel 100 feet wide and 6 feet deep, at an estimated cost of $80,333.

The act of August 11, 1888, directed an examination of the "Chipola River from its mouth to Wewahitchka, and the Cut-off, and Lee Slough, running from the Apalachicola River to the Chipola River," and the original project was extended to include a channel 60 feet wide and 5 feet deep through the Cut-off, Lee Slough, and lower Chipola River.

The present project calls for a channel in the main river 100 feet wide and 6 feet deep, and in the Cut-off and lower Chipola River 60 feet wide and 5 feet deep, together with the removal of snags and other obstructions that may be brought into the stream from time to time.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $59,197.57.

The Apalachicola River, Cut-off, and lower Chipola River were in fairly navigable condition at that date, except that a large accumulation of drift and saw logs, dropped from rafts, rendered navigation through the narrow and crooked channel in Lee Slough difficult and troublesome at periods of extreme low water. During the fiscal year ending June 30, 1900, the snag boats *Flint* and *Chattahoochee* worked over the entire river, removing a large amount of obstructions, which greatly benefited the navigation of the main river, the Cut-off, and Lee

Slough. The maximum draft that could be carried June 30, 1900, at low water over the shoalest part of the channel under improvement was 6 feet.

An allotment of $1,500 from the appropriation provided by the emergency river and harbor act of June 6, 1900, was made July 7, 1900, for snagging work.

The commerce of this river is so combined with that of the Chattahoochee and Flint rivers that a separation is impossible. The commerce of all these streams amounted to about $2,000,000 in 1898, about $4,000,000 in 1899, and about $4,777,196 in 1900.

July 1, 1899, balance unexpended	$3,302.43
June 30, 1900, amount expended during fiscal year	3,292.66
July 1, 1900, balance unexpended	9.77
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	13,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix S 3.)

4. *Upper Chipola River, Florida, from Marianna to its mouth.*—This river, from Marianna to the head of the Dead Lakes, has a general low-water depth of 5 feet and width varying from 60 to 200 feet. It is greatly obstructed by rock shoals, snags, and overhanging trees. Three bridges form obstructions, their headways above low water being 17, 16, and 15 feet, respectively.

No funds were available for the improvement of this stream until an appropriation of $5,000 was made by act of March 3, 1899, to be expended in accordance with project submitted. This project contemplates clearing out a low-water channel 3 feet deep and 60 feet wide from Marianna to the foot of the Dead Lakes, estimated to cost $41,000, exclusive of necessary plant, which would comprise a snag boat, drilling barge, and dump scow. (See Annual Report of the Chief of Engineers for 1899, p. 1417.)

The project for expenditure of the amount appropriated is to clear a channel through the Dead Lakes, from the Cut-off to the head of the lakes, of all snags, logs, and fallen trees, and mark the channel with prominent guides to indicate it, and to work upstream on that portion of the river from the head of the Dead Lakes toward Marianna, removing such obstructions as may be met with, and as far as the funds available will permit. This project was modified by authority of the Secretary of War, June 30, 1899, so far as to permit the work to begin at Marianna and work on that section of the river to Look and Tremble Shoal.

The work is practicable except at Look and Tremble Shoal, 45 miles below Marianna, where the fall is such at low water that a cut through the shoal would ruin the channel for more than a mile above it. Improvement at this point would require a lock, but probably no dam. A small timber-crib lock would probably satisfy the needs of the commerce interested, but available data does not permit an estimate being made of its cost.

The maximum draft that could be carried on June 30, 1900, at low water over Look and Tremble, the worst shoal within the limits of the improvement, was 2.5 feet.

The commerce of this stream consists principally of naval stores, round and square timber, lumber, and other miscellaneous freights, the estimated value of which was on June 30, 1900, $540,000. With a lock built at Look and Tremble Shoal, to enable boats to pass over it up to Marianna without breaking cargo, this commerce would undoubtedly be largely increased.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	4,950.55
July 1, 1900, balance unexpended	49.45
July 1, 1900, outstanding liabilities	15.37
July 1, 1900, balance available	34.08
Amount (estimated) required for completion of existing project	36,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix S 4.)

5. *Flint River, Georgia.*—At low water this river was navigable for boats drawing 3 feet only from its mouth to Bainbridge, Ga., but the channel was narrow, crooked, and greatly obstructed by logs, snags, and overhanging trees. Above Bainbridge the channel was so obstructed by rock shoals, loose rock, and bowlders that there was no navigation, except on a rise of 4 feet, when steamboats could run to Albany, 105 miles above its mouth. Above Albany to Montezuma the channel was so obstructed by sand and rock shoals, bowlders, snags, logs, and overhanging trees that the river was not navigable at a low-water stage.

The original project called for a channel 100 feet wide and 3 feet deep at extreme low water from the mouth of the river to Albany, Ga., at an estimated cost of $184,862.

This project was amended in 1870 to give a channel for light-draft steamers at moderate stages of water from Albany to Montezuma by the removal of logs, snags, and overhanging trees, cutting through rock reefs, and deepening sand bars by contraction works, at a cost of $15,000. The amount expended up to the close of the fiscal year ending June 30, 1899, was $204,755.88, which resulted in making a good navigable low-water channel from the mouth of the river to Bainbridge, Ga., and opened up a permanent low-water channel through the rock reefs from Albany down the stream toward Bainbridge as far as Kennedy Shoals, 36½ miles below Albany.

A navigable depth of 3 feet is available on that part of the river between its mouth and Bainbridge, and the same depth is available in that part between Albany and Kennedy Shoals below. On that part of the river between Kennedy Shoals and Bainbridge the river is so badly obstructed by shoals, rock reefs, and bowlders that there is no navigable channel at a low-water stage.

The work during the fiscal year ending June 30, 1900, was confined to removing isolated bowlders, snags, and logs, and blasting through rock reefs on that part of the river between Albany and Newton and between Cheevertown and Bainbridge. The partial work done on this portion improved it to such an extent that boats drawing 3 feet were enabled to get from the stills just above Cheevertown to Bainbridge at low water; but this work was not completed. No work was attempted in the shoals just below Newton, as there were not sufficient funds available for this purpose. The condition of the river at present is that it is navigable from its mouth to Bainbridge and from Newton to Albany, leaving a gap between Bainbridge and Newton to be worked over, on which navigation is only attempted on a 5-foot rise in the river. The maximum draft that can be carried at low water on the improved part of this river is 3 feet.

The commerce of the lower part of this stream is so combined with that of the Chattahoochee and Apalachicola rivers that it is impossible to give a separate statement in regard to it. The commerce of that part below Albany down as far as the improvement has been carried is estimated to be 17,655 tons, valued at $982,025. As a result of the improvements made, a new steamboat will soon be placed on this part of the river.

July 1, 1899, balance unexpended	$6,244.12
June 30, 1900, amount expended during fiscal year	5,373.88
July 1, 1900, balance unexpended	870.24
July 1, 1900, outstanding liabilities	30.94
July 1, 1900, balance available	839.30
Amount (estimated) required for completion of existing project	117,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S 5.)

6. *Chattahoochee River, Georgia and Alabama.*—(*a*) *Below Columbus.*—Columbus, Ga., 223 miles above the junction of this river with the Flint River, is at the head of navigation, and the river has always been navigable to this point, but it was difficult and dangerous by day and impossible by night, owing to the large accumulation of logs, snags, overhanging trees, sand, rock, and marl shoals obstructing the channel, which had an available depth of 3 feet. In the bar chutes and over the shoals the width was restricted, but ample for the purposes of navigation.

The original project for its improvement provided for a low-water channel 100 feet wide and 4 feet deep from Columbus, Ga., to Chattahoochee, Fla., at the junction of the Flint, which was to be obtained by the removal of logs and snags from the channel, overhanging trees from the banks, cutting through the rock and marl shoals, and scouring out sand bars by works of contraction and shore protection. The estimated cost of this work from Chattahoochee, Fla., to Eufaula, Ala., 139 miles, is given as $145,247. No estimate of cost can be found for that part between Eufaula, Ala., and Columbus, Ga.

The amount expended on this work to the close of the fiscal year ending June 30, 1899, was $309,996.80.

The river was in a fair condition at that date, with an available low-water depth of 3½ feet below Eufaula, Ala., but between Eufaula and Columbus there were a number of bars and isolated obstructions which caused trouble, particularly at extreme low-water stages of the river; navigation between those points was then virtually suspended.

During the past fiscal year the river was worked over between Columbus and Chattahoochee, the snag boats removing a number of obstructions from the channel and the sand bars at Shell Creek, Crab Apple Bend, Gunboat Shoals, Cowega Creek, St. Francis Bend, and Youngs Bend. A large number of sand bars and shoals still exist between Columbus and Eufaula that need improvement, and numerous landslides came into the river during the last winter's rise which will have to be removed.

The maximum draft that can be carried over the shoalest part of the river under improvement is scant 3 feet.

The commerce of this stream is so combined with that of the Flint and Apalachicola rivers that a separation is impossible. It is stated under the report for the Flint River as being 86,858 tons, valued at $4,777,190, in 1900, as against 72,510 tons, valued at $4,288,000, in 1899.

July 1, 1899, balance unexpended		$45,003.20
June 30, 1900, amount expended during fiscal year		13,077.32
July 1, 1900, balance unexpended		31,925.88
July 1, 1900, outstanding liabilities	$2,869.42	
July 1, 1900, amount covered by uncompleted contracts	13,749.00	
		16,618.42
July 1, 1900, balance available		15,307.46
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		80,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(*b*) *Between Westpoint and Franklin.*—This section of the river is 38 miles long, and is divided into a series of pools, varying in length from half a mile to 5 or 6 miles, by rock shoals and rapids, some of which have a fall as great as 8 feet in a mile. The width of the pools varies from 300 to 500 feet, with a depth of not less than 4 feet. The width on the shoals is from 800 to 1,000 feet, with a depth of water of only a few inches. There was, therefore, no navigable channel, and it was not available for purposes of navigation.

The river and harbor acts of 1892, 1894, and 1896 each provided that $5,000 of the sum appropriated for the Chattahoochee River, Georgia and Alabama, should be spent on this section, the project adopted being to "remove the lesser rock shoals, sand, and gravel bars by excavation and works of contraction; to remove overhanging trees from the banks, and snags, logs, and other obstructions from the channel, and to overcome the more serious obstructions by the construction of locks and dams, to give a minimum depth of 3 feet at low water in the channel between Westpoint and Franklin, a distance of 38 miles."

The amount expended on this work to June 30, 1899, was $9,630.84, which resulted in obtaining a low-water channel 50 feet wide and 3 feet deep through Roberts, Flat Rock, and Haynes Island shoals, the river still remaining unavailable for purposes of navigation except over that part improved as above stated.

No work was done during the fiscal year ending June 30, 1899, the river remaining in the same condition as stated for the fiscal year ending June 30, 1898.

By act of March 3, 1899, the balance of the funds on hand, $5,369.16, together with an additional amount of $5,000, or so much as should be necessary, from the appropriation for the Chattahoochee River, was made available for a survey over this part of the river.

In accordance with the provisions of the above-recited act a survey was made, beginning at Franklin, Ga., and ending at Westpoint, Ga., covering a distance of 38.66 miles.

There is no commerce on this part of the river at present.

July 1, 1899, balance unexpended	$10,369.16
June 30, 1900, amount expended during fiscal year	10,077.71
July 1, 1900, balance unexpended	291.45
July 1, 1900, outstanding liabilities	127.77
July 1, 1900, balance available	163.68

(See Appendix S 6.)

7. *Choctawhatchee River, Florida and Alabama.*—Before any work of improvement was commenced in this river the channel way was greatly obstructed by large and dangerous snags, sunken logs, overhanging timber, and by sand and gravel bars. The channel was exceedingly dangerous, and not available for safe navigation or for the purposes of commerce.

The project for improvement adopted in 1880 provided for a low-water channel from the mouth of the river to Geneva, Ala., 125 miles, and a navigable high-water channel from Geneva to Newton, Ala., 37 miles.

The project was amended in 1890 to provide a low-water channel from Geneva to Newton.

By the provisions of the river and harbor act of 1890 it was required that a draw be put in Hollis Bridge, crossing the river between Geneva and Newton, before any part of the sum appropriated could be expended above said bridge. The present project, under the provisions of the act of March 3, 1899, directs that of the sum appropriated ($16,000) $10,000 shall be expended between Geneva and Newton. These improvements were to be accomplished by removing logs and snags from the channel and overhanging trees from the banks, by excavating rock and marl shoals, and by deepening sand bars by contraction works, protecting the banks where necessary.

The amount expended on this river up to the close of the fiscal year ending June 30, 1899, was $143,944.57.

The work accomplished under the approved project had secured a good navigable low-water channel from Geneva, Ala., to Caryville, Fla., with a depth of 3½ feet and a width varying from 60 to 120 feet, the narrow portions being confined to the bars, which have been deepened by contraction works. A partly improved low-water channel exists between Geneva and Newton as far as Pates Landing, a distance of 25 miles.

No work further than the care and preservation of the public property was undertaken during the fiscal year ending June 30, 1899.

Between Geneva, Ala., and Caryville, Fla., 3½ feet is the maximum draft that can be carried over the shoalest bars. This part of the river is constantly used by steamboats.

The commerce of this stream is mainly cotton, miscellaneous stores, saw logs, timber, and lumber. It was reported in 1899 as 18,663 tons, valued at $1,000,000, and an estimated value of the logs and timber of $1,500,000, making a total of $2,500,000.

Whenever the river was at a working stage during the fiscal year ending June 30, 1900, the snag boat was employed in removing obstructions between Caryville, Fla., and Geneva, Ala. During a rise in the river she was employed on that portion between Geneva and Newton. Steamers carrying large freights can run regularly by day or night between Caryville and Geneva, and make occasional trips between Geneva and Pates Landing, above Geneva. The lower part of the river, between Caryville and its mouth, is not used by steamboats, but serves to carry immense quantities of saw logs and hewn timber to the booms at the mouth of the river. This part of the river will probably be of more importance to navigation than formerly, owing to the increased commerce of the Holmes River, due to the improvements made on that stream. The bar at the mouth of the river (Cypress Top), which has shoaled to about 2.5 feet, should be deepened by dredging to at least 5 feet, to enable tugs to handle the large quantities of timber stored in the various mouths of this stream awaiting distribution to various points of shipment.

July 1, 1899, balance unexpended	$15,932.05
June 30, 1900, amount expended during fiscal year	5,302.44
July 1, 1900, balance unexpended	10,629.61
July 1, 1900, outstanding liabilities	760.63
July 1, 1900, balance available	9,868.98
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and maintenance, in addition to the balance available July 1, 1900	23,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix S 7.)

8. *La Grange Bayou, Florida, including Holmes River, Florida, from Vernon to its mouth.*—Holmes River empties into the Choctawhatchee River about 40 miles above its mouth. It is a wide and deep stream up to the town of Vernon, but greatly obstructed by sunken logs, fallen timber, and overhanging trees, and was only available for navigation by small sailing craft and barges, which occasionally made trips up to Vernon.

The present project for the improvement of the stream provides for making a navigable channel, by removing logs and snags from the channel and overhanging trees from its banks, from its mouth up to the town of Vernon.

The total amount expended on this improvement up to the close of the year ending June 30, 1899, was $5,160.80 (of which $3,000 was upon Holmes River and $2,160.80 upon La Grange Bayou), and resulted in clearing the channel of all obstructions that were then found, making the channel sufficiently available for the small craft that used the stream.

Nothing was done during the fiscal year ending June 30, 1899. By act of March 3, 1899, the balance, $4,839.20, previously returned to the Treasury, was reappropriated, and work resumed in removing obstructions which had accumulated since the river was worked in 1891. There are no bars on this portion of the river, the depth being ample for the commerce interested.

The commerce of the stream consists of cotton, turpentine, rosin, molasses, honey, and miscellaneous articles, which are carried by water to Pensacola to market.

July 1, 1899, balance unexpended	$4,839.20
June 30, 1900, amount expended during fiscal year	1,983.70
July 1, 1900, balance unexpended	2,855.50
July 1, 1900, outstanding liabilities	367.30
July 1, 1900, balance available	2,488.20

(See Appendix S 8.)

9. *Harbor at Pensacola, Fla.*—The available depth across the inner bar at the entrance to this harbor in 1879, previous to any work of improvement being carried on, was 19.5 feet, the width of the channel being contracted by the growth of the Middle Ground Shoal to the south. The harbor entrance and channel way was also found to be obstructed by wrecks, and the western shore line in the vicinity of Fort McRee was cutting away rapidly, and almost the whole of old Fort McRee had been washed away.

The project of 1877 considered only the removal of the wrecks; that of 1878 called for the removal of these wrecks and for making a survey to determine further recommendations for improvement. The project of 1881 provided for dredging a channel 300 feet wide and 24 feet deep at mean low water for the temporary relief of navigation, and also for protecting the shore line near Fort McRee with a view of preventing further injurious changes in the tidal currents and also retaining the position for defensive purposes. Dredging under this project was carried on at various times between 1881 and 1893, and at the close of the dredging operations in August, 1893, the available channel was 225 feet wide with a depth of 24 feet at mean low water. Two groins, one 360 and the other 220 feet long, were completed in 1890 and still serve the purpose of holding the shore line.

In 1891 a special Board of Engineers presented a project for opening a new channel across the Caucus Shoal, following the direction of the ebb current, by means of two jetties, assisted by dredging if necessary. The estimated cost of this project was $1,830,000. In 1895, upon the report of a special Board of Engineers, no change was made in the project of 1891, but it was recommended that dredging be tried, by using one of the hydraulic dredges belonging to the United States, to open up a channel 26 feet deep at mean low water and as wide as practicable on the line of the deepest water across the Caucus Shoal and approximately on the line of the axis of the jetty channel proposed by the Board in 1891. In December, 1895, this channel was opened by the U. S. dredge *Gedney* to a width of 120 feet and depth of 24 feet at mean low water.

In 1896 the same Board that recommended the first amendment to the project of 1891 submitted a second amendment to expend all funds available in continuing the work of dredging across the Caucus Shoal, and if funds sufficient were made available by Congress to build a dredge and open the channel across the Caucus Shoal to a width of at least 300 feet with a 30-foot depth at mean low water, with such side slopes as the material would assume. Until a channel be opened by dredging across the Caucus Shoal, as above proposed, the Board recommended that the construction of jetties for its maintenance be not considered.

The river and harbor act of March 3, 1899, extended this project to "securing a channel depth of 30 feet at mean low water from the Gulf of Mexico to the dock line at the east end of the city of Pensacola."

The amount expended up to the close of the fiscal year ending June 30, 1899, was $547,161.32. The work done has resulted in the removal of the wrecks obstructing the channel, in the construction of two groins near old Fort McRee, which have served the purpose of retaining the shore line, and are now in good condition, and in dredging a large amount of material from the inner bar, and opening up an entirely new channel across the Caucus Shoal, with a width of 150 feet and depth of 25.8 feet at mean low water.

At the beginning of the past fiscal year dredging under contract was in progress, but closed on the 6th of January, 1900, giving an available depth through the Caucus Channel of 31.2 feet at mean low water.

At the close of the fiscal year this channel, with a maximum draft of 28.7 feet at mean low water over its shoalest part, was used by all the large deep-draft seagoing vessels that load at Pensacola. Very few vessels use the old channel across the inner bar.

In view of the large amount of dredging required in Pensacola Harbor for securing and maintaining the requisite channel depths, it is considered very desirable that a Government dredging plant should be secured, and the cost of such plant is included in the estimate submitted.

The commerce of this port is very large. For the fiscal year ending June 30, 1899, the foreign and coastwise exports were reported as $14,936,084, and in 1900 as $14,828,580.

July 1, 1899, balance unexpended		$172,838.68
June 30, 1900, amount expended during fiscal year		98,846.64
July 1, 1900, balance unexpended		73,992.04
July 1, 1900, outstanding liabilities	$508.27	
July 1, 1900, amount covered by uncompleted contracts	56,200.00	
		56,708.27
July 1, 1900, balance available		17,283.77
Amount (estimated) required for completion of existing project		683,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$170,000.00	
For maintenance of improvement	10,000.00	
		180,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix S 9.)

10. Blackwater River, Florida and Alabama.—This stream is deep from 12 miles above Milton, Fla., to its mouth, with the exception of a shoal known as Hunts Bar, one-half mile below Bagdad, Fla. This shoal is a compact sand bar about 250 feet wide, with a depth of 6 feet at mean low water, and extends obliquely across the river.

An appropriation of $5,000 was made by act of March 3, 1899, for expenditure in accordance with project submitted (see Annual Report of the Chief of Engineers for 1882, p. 1309), as follows:

1. The reduction of one of the lumps known as the "Beer Garden."
2. The dredging of a channel through the sand ridges 100 feet wide to a depth of 9 feet at mean low water (about 3 feet of dredging) and 2,500 feet long.
3. The cutting of a channel of like width and depth through Hunts Bar.

The estimated cost is $20,000.

The project adopted for the expenditure of the amount appropriated provides for cutting a channel 100 feet wide to a depth of 9 feet at mean low water (about 3 feet of dredging) through Hunts Bar.

Operations were commenced on January 20, 1900, and the dredging was continued until June 23, 1900, and resulted in obtaining a channel through Hunts Bar 100 feet wide and 11 feet deep. The depth of water on Hunts Bar and between the bar and Milton, the head of navigation, now exceeds that in Blackwater Bay and Upper East Bay.

The commerce of this river is principally lumber and timber, which is carried to Pensacola, Fla., for export. It is quite large, but no information as to its amount has been obtained.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	4,366.66
July 1, 1900, balance unexpended	633.34
July 1, 1900, outstanding liabilities	615.14
July 1, 1900, balance available	18.20

(See Appendix S 10.)

11. Escambia and Conecuh rivers, Florida and Alabama.—The channel of this river before any improvement was attempted was much obstructed by rock shoals and sand bars, on some of which there was a depth of only 2 feet, by large, dangerous snags, sunken logs, and overhanging trees, making a rise of several feet necessary for the safe passage of timber and saw logs, which constitute the principal products of the country adjacent, which depends upon this stream for its transportation facilities to a market. A bar at the mouth of the river where it empties into Escambia Bay also caused much trouble and delay. The project for improvement provides for a channel from its mouth to Indian Creek in Alabama, by the removal of snags, logs, and other sunken obstructions, for cutting through rock shoals, deepening the sand bars by works of contraction, and for dredging a channel through the bar at its mouth.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $92,855.86.

The channel way has been kept open for the passage of rafts during low-water stages, but the bar at the mouth still forms an obstruction to passage of the tugs which make up the tows at the mouth of the river for transportation to the shipping lying off the port of Pensacola.

Under an appropriation of $5,000, made by act of March 3, 1899, snagging operations were continued until the high water of the fall of 1899, which resulted in maintaining sufficient depth and width in the channel for the passage of the large number of rafts and logs floated down this stream. An allotment of $1,500, from the appropriation provided by the emergency river and harbor act of June 6, 1900, was made July 7, 1900, for snagging work.

The maximum draft that can be carried at low water over the shoalest part of the river considered within the improvement is 2 feet.

The commerce of this stream is mainly timber, lumber, and saw logs. It was valued in 1895 at $2,000,000, and is now reported as being valued at about 60 per cent of the timber export trade of Pensacola.

July 1, 1899, balance unexpended	$4,644.14
June 30, 1900, amount expended during fiscal year	4,137.83
July 1, 1900, balance unexpended	506.31
July 1, 1900, outstanding liabilities	19.01
July 1, 1900, balance available	487.30
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix S. 11.)

12. Alabama River, Alabama.—The river in its original condition was so obstructed by logs, snags, fallen trees in the channel, overhanging timber on its banks, and by bars and shoals, on many of which a depth of only 2.5 feet was found at low water, that safe navigation was practicable only in daylight.

The original project for its improvement contemplated making a channel 4 feet deep at low water, with a minimum width of 200 feet, to be obtained by removing logs and snags from the channel, overhanging trees from the banks, cutting through rock and gravel bars by blasting and dredging, and deepening sand bars by works of contraction and shore protection. This project was amended in 1891 (see Annual Report of the Chief of Engineers for 1891, p. 1761) so as to increase the low-water depth to 6 feet from Wetumka, Ala., to the junction of the Alabama and Tombigbee rivers.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $346,152.16.

The condition of the improvement at that date was such that the river was navigable, by night as well as by day, between Montgomery and Mobile during a greater part of the year.

Owing to a long period of drought that prevailed throughout the watershed of this river during the summer of 1898 the river fell to 0.8 below the zero of the Montgomery gauge. Upon some of the shoals between Montgomery, Ala., and Hurricane Bluff, 52 miles below Selma, upon which no work of improvement had been undertaken, the available depth was only 2.5 feet. During this period of low water this portion of the river was not available for the purposes of navigation. This condition only lasted a short while, as during the autumn of 1898 the river rose and remained at a stage that afforded good navigation throughout the remainder of the low-water season.

Under an appropriation of $50,000, made by act of March 3, 1899, operations were continued by the snag boat, and at the close of the fiscal year many obstructions had been removed over the entire length of the river.

No increase in depth and width occurred during the fiscal year, as no contraction works of any kind were built.

The maximum depth that could be carried June 30, 1900, at low water, over the shoalest part of the river, with the gauge reading zero at Montgomery, was 3 feet.

The commerce of this stream is important, consisting principally of cotton, cotton seed, fertilizers, grain, lumber, shingles, naval stores, staves, and a large quantity of miscellaneous freight of all descriptions, estimated in 1899 as 76,529 tons, valued at $6,887,000.

July 1, 1899, balance unexpended		$48,847.84
June 30, 1900, amount expended during fiscal year		7,893.86
July 1, 1900, balance unexpended		40,953.98
July 1, 1900, outstanding liabilities	$1,936.65	
July 1, 1900, amount covered by uncompleted contracts	13,440.00	
		15,376.65
July 1, 1900, balance available		25,577.33
Amount (estimated) required for completion of existing project		196,251.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix S 12.)

13. Coosa River, Georgia and Alabama.—The Coosa River extends from Rome, Ga., where it is formed by the junction of the Oostenaula and Etowah rivers, to a point 18 miles above Montgomery, Ala., where it unites with the Tallapoosa River to form the Alabama. Its length is about 315 miles.

The river was available for navigation from Rome to Greensport, Ala., a distance of 162 miles, before any improvement was made. From Greensport to Wetumka, Ala., 142 miles, the bed of the stream is so much broken up with reefs and shoals of rock as to make its navigation practically impossible. Many years ago cotton was carried down the river to Mobile on flatboats at high water, but no boats ever came back.

The river is divided by legislative action into two parts—that lying between Rome and the East Tennessee, Virginia, and Georgia Railroad Bridge and that lying between the bridge and Wetumka. The first is 236 miles long; the second is 68 miles.

(*a*) *Between Rome, Ga., and the East Tennessee, Virginia and Georgia Railroad Bridge.*—The original project for this part of the stream contemplated a channel 3 feet deep and 80 feet wide. The width and depth were changed below Lock No. 3 to Lock No. 4 to 100 feet and 4 feet, respectively, and from and including Lock No. 4 to 100 feet and 7 feet, respectively.

The contemplated improvement was to be made by works of contraction at the lesser obstructions and locks and dams at the greater.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $963,695.85.

The condition of the river at that date was such that it was navigable the entire year for steamboats from Rome, Ga., to Harts Ferry, Ala., 1 mile below Lock No. 3, and at times from Harts Ferry to Lock No. 4.

During the past fiscal year work was mostly prosecuted on that part of the river between Locks Nos. 3 and 4 by blasting and dredging through the rock reefs and building contraction works. While a 3-foot channel has been secured through most of these shoals, there is yet work to be done in deepening and widening all of them.

The navigable channel, 3 feet in depth, has been increased by 21 miles, except at Alligator Reef, where there is a low-water depth of 2.3 feet.

On June 30, 1900, the maximum draft that could be carried at ordinary low water over the shoalest part of the river that has been put under improvement between Rome, Ga., and Lock No. 4 is 2 feet. Below Lock No. 4 the improvements will consist of a series of locks and dams upon which no work has been undertaken. This part of the river is, therefore, not navigable.

The commerce of this portion of the river is of great importance. It consists principally of cotton, cotton seed, fertilizers, timber, lumber, staves, grain, and miscellaneous articles. In 1899 its tonnage was 66,936, valued at $2,000,000; in 1900 it was 50,578, valued at $2,778,490.

July 1, 1899, balance unexpended	$20,004.15
Amount transferred from appropriation for operating and care of canals etc. (value of 435 barrels cement)	1,322.40
	21,326.55
June 30, 1900, amount expended during fiscal year	16,097.76
July 1, 1900, balance unexpended	5,228.79
July 1, 1900, outstanding liabilities	1,672.67
July 1, 1900, balance available	3,556.12
Amount (estimated) required for completion of existing project	1,158,523.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	450,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(*b*) *Between the East Tennessee, Virginia and Georgia Railroad Bridge and Wetumka, Ala.*—The original condition of this part of the Coosa River was such that navigation was impossible. The river was formed of a series of short, deep pools, seldom more than a mile in length, separated from each other by a series of rock reefs and shoals, some of which are as much as 12½ miles in length. It was, therefore, not available for the purposes of navigation. Many years ago cotton was floated down the river to Wetumka and Montgomery in flatboats at periods of high water, but the boats were never able to return, as the fall on many of the shoals and rapids was too great for any vessel to overcome.

The present project for improvement contemplates canalizing the river by the construction of 23 locks and dams, with 6 feet depth on the miter sills of the locks, and clearing the channel between the locks by cutting through the rock reefs, so as to give a navigable depth of 4 feet at low water.

The amount expended to June 30, 1899, was $378,306.94.

The walls of Lock No. 31 are finished and ready to receive the gates and machinery for maneuvering the valves for filling and emptying the lock. The cofferdam has been removed, the space between the land wall and the river bank filled up and protected, and a large amount of channel work done above the lock. As this is the only work that has been undertaken on this division of the river, the stream was not available for the purposes of navigation at the close of the fiscal year ending June 30, 1899.

No work was done during the year ending June 30, 1900, with the exception of care and preservation of the public property belonging to the improvement, and making necessary repairs to the lock house and grounds. No change in the channel way as to depth, width, or other facilities was made during the year.

The bed of the stream is so much obstructed with shoals and reefs of rocks that there is no defined low-water channel, and the maximum draft can not be stated.

The condition of this part of the Coosa River is such that the entire section must be improved and connection made above and below before any commerce can be developed.

In a report submitted January 20, 1897, a Board of Engineer Officers recommended that, if work on this section of the Coosa River was to be continued, it should be under appropriations of not less than $500,000 per year.

July 1, 1899, balance unexpended	$31,693.06
June 30, 1900, amount expended during fiscal year	2,224.60
July 1, 1900, balance unexpended	29,468.46
July 1, 1900 outstanding liabilities	229.81
July 1, 1900, balance available	29,238.65
Amount (estimated) required for completion of existing project	4,916,390.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S 13.)

14. *Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.*—The expenses of operating and care of Locks Nos. 1, 2, and 3, and the canal between Locks Nos. 2 and 3 during the fiscal year ending June 30,1900, amounting to $5,907.16, exclusive of outstanding liabilities ($2,406.58) on June 30,1900, have been paid from the permanent-indefinite appropriation provided by section 4 of the act of July 5, 1884.

(See Appendix S 14.)

EXAMINATIONS AND SURVEYS REQUIRED BY THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. C. A. F. Flagler, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Peter C. Hains, Corps of Engineers:

1. *Preliminary examination and plan and estimate for improvement of Ocklockonnee River, Florida.*—Captain Flagler submitted reports dated June 24, 1899, and October 4, 1899, respectively, with plan for improvement at an estimated cost of $2,650. The reports were transmitted to Congress and printed in House Doc. No. 55, Fifty-sixth Congress, first session. (See also Appendix S 15.)

2. *Preliminary examination and plan and estimate for improvement of east pass at entrance to Carrabelle Harbor, Florida.*—Captain Flagler submitted reports dated June 24 and October 31, 1899, respectively, with plan for improvement at an estimated cost of $27,450. I[illegible]

opinion the locality is worthy of improvement by the General Government, and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 63, Fifty-sixth Congress, first session. (See also Appendix S 16.)

Captain Flagler was also charged with the duty of making a survey of *Chattahoochee River, Georgia, between Westpoint and Franklin*, required by section 1 of the river and harbor act of March 3, 1899, and report thereon will be submitted to Congress at its next session.

EXAMINATION OF CARRABELLE HARBOR, FLORIDA, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Carrabelle Harbor, Florida*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN ALABAMA AND EASTERN MISSISSIPPI AND OF BOGUE CHITTO, LOUISIANA.

This district was in the charge of Maj. William T. Rossell, Corps of Engineers, having under his immediate orders Lieut. James B. Cavanaugh, Corps of Engineers, to June 10, 1900. Division Engineer, Col. Peter C. Hains, Corps of Engineers, to July 8, 1899, and since October 27, 1899.

1. *Mobile Harbor, Alabama.*—This channel had originally a depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar.

The original project was for a channel 10 feet deep at mean low water through Choctaw Pass and Dog River Bar.

From 1870 to 1878 the channel was deepened to 13 feet under a project submitted August 5, 1870, for a channel 300 feet wide and 13 feet deep at mean low water.

From 1881 to 1888 the channel was deepened to 17 feet under a project submitted for a channel 200 feet wide and 17 feet deep at mean low water, adopted in March, 1880. Before this project was completed a project was submitted and adopted in August, 1888, to dredge a channel of entrance from the Gulf of Mexico to the city of Mobile of 280 feet width on top of cut, with a central depth of 23 feet at mean low water.

Act of September 19, 1890, extended the work up Mobile River to the mouth of Chickasabogue Creek and increased the estimated cost to $2,043,800, with entire length of channel 33.09 miles and the entire length of continuous cut of 32.27 miles. This work was placed under continuous contract by act of July 13, 1892.

Joint resolution of Congress approved March 16, 1896, revived the continuous contract and increased the amount by $160,000. Work under this resolution was suspended September 5, 1896.

Act of June 3, 1896, appropriated $60,000 for maintenance of the channel by dredging, and work was carried on under this appropriation until March 11, 1898.

Act of June 4, 1897, appropriated $25,000 for maintaining the channel, and under this appropriation the work continued without interruption from March 11, 1898, until June 21, 1898, when the funds were exhausted.

The sundry civil act of July 1, 1898, appropriated $30,000 for maintenance of the channel. Under this appropriation work was begun December 21, 1898, and continued until May 9, 1899, when funds were exhausted.

Act of March 3, 1899, appropriated the sum of $100,000 and granted authority to enter into continuous contract or contracts to the amount of $500,000 in addition, with a view of securing ultimately a channel 23 feet deep and 100 feet wide at bottom, with appropriate side slope. The $500,000 mentioned in this act was appropriated by sundry civil act approved June 6, 1900.

It is understood that Congress by this item of appropriation adopts the project published in House Doc. No. 199, Fifty-fourth Congress, first session, and printed on page 1463 of the Annual Report of the Chief of Engineers for 1896.

A contract was entered into with the National Dredging Company for this work, and operations have been carried on under this contract during the entire fiscal year.

Since 1888 the total amount expended on the improvement to June 30, 1899, is $2,271,108.41. At the beginning of the fiscal year there was a channel of navigable width with a depth varying from 19 to 22 feet at mean low water, but available throughout its length for vessels drawing 22.5 feet, on account of the softness of the material which had filled in.

During the fiscal year 4,273,381 cubic yards of material has been removed from Mobile Bay, resulting in a channel varying in width from 40 to 150 feet for a total distance of over 12 miles dredged to a depth of 25 feet.

Commercial statistics.

[Compiled from the records of the Mobile Cotton Exchange.]

Articles.	1900.	1899.	1898.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Lumber	212,696	123,098	76,079	106,095
Timber	190,762	164,232	97,765	191,772
Cotton	51,469	65,647	86,550	76,847

July 1, 1899, balance unexpended		$97,691.59
Amount appropriated by sundry civil act approved June 6, 1900		500,000.00
		597,691.59
June 30, 1900, amount expended during fiscal year		85,804.75
July 1, 1900, balance unexpended		511,886.84
July 1, 1900, outstanding liabilities	$226,317.53	
July 1, 1900, amount covered by uncompleted contracts	285,569.31	
		511,886.84
Amount (estimated) required for completion of existing project		1,040,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900		350,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 1.)

2. Black Warrior River, Alabama.—The original condition of this river was such as to be practically closed to navigation on account of shoals at and above Tuscaloosa.

The name "Black Warrior" is given to that portion of the Warrior River which lies above the city of Tuscaloosa, Ala.

The original project for improvement of this river was approved in 1887, the object being to obtain a channel 6 feet deep, by means of five locks and dams, from Tuscaloosa to Daniels Creek, 15 miles, at an estimated cost of $741,670.

During the fiscal year of 1896 three locks were completed, giving a total lift of 30.3 feet. All locks of the system are to be 50 feet wide, 322 feet between hollow quoins, and 285 feet available length.

River and harbor act of March 3, 1899, provided for the construction of Lock No. 4 on this river, at a cost not to exceed $190,500, and so far there has been $136,824 appropriated for the work. Contract has been entered into, and the lock is now being built.

The total amount expended on this improvement to June 30, 1899, was $602,125.32.

July 1, 1899, balance unexpended		$51,624.68
Amount appropriated by sundry civil act approved June 6, 1900		86,824.00
		138,448.68
June 30, 1900, amount expended during fiscal year		11,146.12
July 1, 1900, balance unexpended		127,302.56
July 1, 1900, outstanding liabilities	$6,410.93	
July 1, 1900, amount covered by uncompleted contracts	163,348.00	
		169,758.93

Amount (estimated) required for completion of existing project	53,676.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	53,676.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T 2.)

3. Operating and care of locks and dams on Black Warrior River, Alabama.—These locks and dams are near Tuscaloosa, Ala., and are known as Locks Nos. 1, 2, and 3, Black Warrior River, Alabama. They were finished and opened to commerce in November, 1895, and on July 1, 1896, their operation and care became a charge under the general law of July 5, 1884.

During the past fiscal year these locks have been operated by two lock hands at each lock under the supervision of a lock master. In addition to their operation much repair work was done to the locks.

The total expense during the year for operating and repair was $8,505.24.

The commerce through the locks during the year ending June 30, 1900, amounted to 757 tons coal, 764 tons timber, 42 tons building material, 38 tons cotton, 285 tons general merchandise.

(See Appendix T 3.)

4. Warrior and Tombigbee rivers, Alabama.—(*a*) *Warrior River, Alabama.*—In its original condition this river was obstructed to such an extent by snags, logs, overhanging trees, etc., as to make navigation at low water impossible, and dangerous during high water. The minimum depth of channel was 1 foot and minimum width 60 feet.

The original project for the improvement was to deepen the channel by jetty construction and to remove snags and overhanging trees so as to obtain for small boats a low-water channel 80 feet wide and 4 feet deep, at an estimated cost of $151,103.

In 1897 an estimate of $1,320,000 was submitted for the construction of 6 locks and dams on the Warrior River, to give a lift of 60.2 feet.

River and harbor act of March 3, 1899, provided for building 3 of these 6 locks and dams at a cost not to exceed $660,000. During the fiscal year a contract was entered into for their construction, but the only work yet done by the contractors has been of a preliminary nature.

No snagging has been done since 1897, as there have been no funds available for such, and the river has therefere become much obstructed. During the floods of the spring of 1900 many logs and trees lodged in the channel and numerous "slip-ins" occurred, almost totally blockading the river at some points. It is very essential to the present navigation of Warrior River that these obstructions should be removed. An allotment of $4,000 from the emergency appropriation of June 6, 1900, was made for this purpose July 7, 1900.

The total amount expended on the improvement to June 30, 1899, was $230,306.13.

Commercial statistics.

[Approximate.]

Articles.	1900.	1899.	1898.
	Tons.	*Tons.*	*Tons.*
Cotton	2,300	2,500	1,500
Grain	3,500	3,000	2,500
Iron	30	21	20
Lumber	100	63	60
Timber	74,000	....	....
General merchandise	3,500	2,400	2,000
Total	83,430	7,984	6,080

July 1, 1899, balance unexpended		$219,693.87
Amount appropriated by sundry civil act approved June 6, 1900		200,000.00
		419,693.87
June 30, 1900, amount expended during fiscal year		26,070.20
July 1, 1900, balance unexpended		393,623.67
July 1, 1900, outstanding liabilities	$6,689.27	
July 1, 1900, amount covered by uncompleted contracts	417,230.20	
		423,919.47
Amount (estimated) required for completion of existing project		240,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$240,000.00	
For maintenance of improvement	15,000.00	
		255,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(*b*) *Tombigbee River from its mouth to Demopolis.*—The original condition of the navigable channel of this portion of the river was such as to admit of steamboat navigation during only about six or eight months of the year, or during high water. The minimum width of the channel was about 100 feet and the minimum depth 2 feet. The project of 1879 was to afford a channel of navigable width and 4 feet deep at ordinary low water from the mouth up to Demopolis, Ala., by removal of snags, logs and overhanging trees, and the improvement of the worst bars.

The present project was adopted in 1890, and is to secure a channel 6 feet deep at low water by removal of logs, snags, and trees, and the construction of bank revetment and locks and dams. In 1897 the plans for locks and dams were slightly modified, and the amount required to complete that portion of the improvement was estimated at $600,000. There are to be three locks, each 50 feet wide, 322 feet long (285 feet available length), and with a total lift of 41 feet. Should future appropriations permit, the construction of a second lock will be commenced.

During the year work was confined to lock at McGrews Shoals, completing the walls, and the floor except 55 feet immediately above lower miter sills; filling behind bank wall was about two-thirds finished. The gates and valves have yet to be put in; the dam is to be constructed, and banks of river just above the lock are to be protected.

The total amount expended on the improvement to June 30, 1899, was $331,138.19. The condition of this section of river at that time was such as to permit of its navigation by boats of 6 feet draft during eight or nine months of the year. During the past spring the excessive floods caused many logs and snags to lodge in the navigable channel, and many "slip-ins" occurred from both banks; these have obstructed navigation considerably and should be removed. An allotment of $4,000 from emergency appropriation of June 6, 1900, was made for this purpose July 7, 1900.

Commercial statistics.

[Approximate.]

Articles.	1900.	1899.	1898.
	Tons.	*Tons.*	*Tons.*
Cotton	16,500	17,250	16,250
Grain	3,500	....	....
Iron	30	....	....
Lumber	230,000	220,750	210,239
Timber	75,920	....	....
General merchandise	35,000	30,240	25,200
Total	360,950	268,240	251,689

July 1, 1899, balance unexpended	$48,861.81
June 30, 1900, amount expended during fiscal year	46,601.25
July 1, 1900, balance unexpended	2,260.56
July 1, 1900, outstanding liabilities	206.30
July 1, 1900, balance available	2,054.26
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(*c*) *Tombigbee River from Demopolis, Ala., to Columbus, Miss.*—The original condition of this section of river was such as to admit of navigation only during high water. The minimum width of the channel was 70 feet and the minimum depth was 2 feet, but it was obstructed by snags, logs, overhanging trees, etc.

Up to 1890 all appropriations were made general for the Tombigbee River, and the project for this section was for a 3-foot channel at mean low water, to be secured by removal of obstructions and overhanging trees. By the river and harbor act of September 19, 1890, Congress adopted a channel depth of 6 feet at low water from Demopolis to Columbus. To secure such a channel the building of locks and dams is necessary, but no provision has yet been made by Congress for inaugurating such work. The fall in the river from Columbus to Demopolis is 107.8 feet, and there will be required 10 locks and dams to give slack-water navigation. These will cost about $2,000,000.

The total amount expended on this improvement to June 30, 1899, was $113,941.25. The condition of the river at that date would permit of its navigation by light-draft boats on a slight rise above ordinary low water.

During the past fiscal year this entire section of river was worked over. However, during the recent high waters this part of Tombigbee River suffered also, many logs and snags lodging in the channel and a number of "slip-ins" from the banks occurring. These will be removed during the approaching low-water season, and the boats and plant for use in the work have been put in good condition.

Commercial statistics.

[Approximate.]

Articles.	1900.	1899.
	Tons.	*Tons.*
Cotton	750	818
Cotton seed	225	200
General merchandise	750	600
Total	1,725	1,618

July 1, 1899, balance unexpended	$46,058.75
June 30, 1900, amount expended during fiscal year	16,664.85
July 1, 1900, balance unexpended	29,393.90
July 1, 1900, outstanding liabilities	667.71
July 1, 1900, balance available	28,726.19
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(*d*) *Tombigbee River from Fulton to Columbus, Miss.*—The original condition of this section of river was such that navigation was impossible except during very high water. The minimum width of the channel was 50 feet and the minimum depth 1 foot, and it was much obstructed by logs, snags, and overhanging trees.

The project of 1873 was to obtain a good high-water channel at an estimated cost of $35,000, and was completed in 1882 at a cost of $27,293.65. Work done since has been in preservation.

The first specific appropriation for this portion of the river was made in 1892, and since then $17,582.21 had been expended to June 30, 1899, making the total expenditures on this improvement to that date $44,875.86. The condition of the river at that time was such as to permit of the free passage of large rafts of logs and timber, though there was some accumulation of obstructions.

During the past fiscal year work was carried on from Fulton down to Aberdeen, about 118 miles, to January 15, 1900, leaving the river comparatively free of obstructions; but others have accumulated since, during the high-water season, and they are now being removed.

July 1, 1899, balance unexpended	$5,417.79
June 30, 1900, amount expended during fiscal year	3,934.64
July 1, 1900, balance unexpended	1,483.15
July 1, 1900, outstanding liabilities	92.45
July 1, 1900, balance available	1,390.70
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	4,000.00

(*e*) *Tombigbee River from Walkers Bridge to Fulton, Miss.*—The original condition of this part of the river was such that navigation for even small rafts was possible only during high water, and then it was troublesome and dangerous.

The project of 1888 was to obtain a good high-water channel by the removal of snags, logs, and overhanging trees, at an estimated cost of $11,000, and was completed in 1891 at a cost of $6,517.18. Work done since has been for maintenance.

The total amount expended on this improvement to June 30, 1899, was $13,525.92. The condition of the river at that date was such that large rafts could be brought down on a 3-foot rise above ordinary low water.

During the past fiscal year only ten days' work was performed, in the month of July, 1899, which, with the work performed during May and June, 1899, completed the removal of accumulation of obstructions in maintenance of improvement.

July 1, 1899, balance unexpended	$474.08
June 30, 1900, amount expended during fiscal year	414.15
July 1, 1900, balance unexpended	59.93
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix T 4.)

5. *Noxubee River, Mississippi.*—The original condition of this river was such that navigation was impossible, except by small flats during four or five months of the year. The minimum width of the river was 60 feet and the minimum depth of the channel 1½ feet.

The original project, adopted in 1880, was to afford a channel for small river steamers during nine months of the year from the mouth to Macon, Miss., at an estimated cost of $65,245.25. The project was completed in 1889, at a cost of $47,527.52, and all work done since has been in preservation of same.

The total amount expended on the improvement to June 30, 1899, was $59,343.01. The river was then navigable by light-draft boats from the mouth to State Line, Miss., 49 miles, on a 6-foot stage. Above this point the channel was obstructed by logs, snags, etc., which had accumulated since last work was done.

During the fiscal year ending June 30, 1900, obstructions have been removed from the river from State Line, Miss., to Macon, Miss., 42 miles, and the river is now navigable for light-draft boats to Macon, Miss., the head of navigation, on a 6 to 8 foot stage of water, but it will be necessary to do some work every season or two to preserve this condition.

The wisdom of further improving the river is a question upon which the citizens of the locality are not agreed. During the year petitions have been addressed to the Secretary of War both for and against a discontinuance of the work of improvement and the abandonment of the river as a commercial highway.

July 1, 1899, balance unexpended	$2,656.99
June 30, 1900, amount expended during fiscal year	2,474.61
July 1, 1900, balance unexpended	182.38
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 5.)

6. *Pascagoula River, Mississippi.*—Before this improvement was commenced the channel through the bar at the mouth of the river had a least depth of 3 feet; from the mouth up 10 miles the river was navigable for vessels of 6½ feet draft; thence up to the junction of Leaf and Chickasahay rivers navigation was impossible except during high water. The minimum width of channel was 60 feet and the minimum depth 1 foot, but it was much obstructed by logs and snags.

Under various projects this river was improved by removing obstructions from the junction of the Leaf and Chickasahay rivers, which form the Pascagoula River, down to Moss Point, a few miles above the mouth; from Moss Point to the mouth a channel 12 feet deep and 80 feet wide was dredged, and a dam built at Lowery Island; from the mouth across the bar to the 12-foot contour line in Mississippi Sound, a channel was excavated to a depth of 9 feet and partially completed to a depth of 12 feet.

The river and harbor act of March 3, 1899, made a separate appropriation for improvement of Pascagoula River from 3 miles above the mouth of Dog River to the 12-foot contour line in Mississippi Sound, about 15 miles, no provision being made for snagging, etc., in the river above. Quite a number of obstructions and overhanging trees have accumulated since last work was done, and it is very necessary to the further navigation of the river that these be removed.

The total amount expended on this improvement to June 30, 1899, was $200,500, of which about $21,000 only has been applied to removing obstructions and overhanging trees. No work of this kind has been done since 1897, and there are no funds available for such.

Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement $5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 6.)

7. *Pascagoula River and Horn Island Harbor, Mississippi.*—Under the river and harbor act approved June 3, 1896, a survey was ordered to determine a plan and estimate for improving the mouth of Pascagoula River. This was submitted to Congress and published in House Doc. No. 211, Fifty-fourth Congress, second session; reprinted in the Annual Report of the Chief of Engineers for 1897, page 1718. Under the same act a survey was directed of Horn Island Harbor and Pass. This survey was also made and report thereon transmitted to Congress and published in House Doc. No. 200, Fifty-fourth Congress, second session; reprinted in the Annual Report of the Chief of Engineers for 1897, page 1716.

By the river and harbor act approved March 3, 1899, an appropriation of $50,000 was made for these two places conjointly, and contract or contracts authorized to the extent of $267,600 in addition. This $267,600 was appropriated by sundry civil act approved June 6, 1900. The amount expended on this improvement to June 30, 1899, was $603.83.

No work had been done at the beginning of the fiscal year. During the fiscal year under a contract dated July 1, 1899, and supplemental contract dated November 23, 1899, with Albert G. Delmas, of Scranton, Miss., a channel 150 feet wide and 4,000 feet long was excavated to the projected depth of 20 feet across the "bulkhead" in Horn Island Harbor, where the depth of water was previously about 17.5 feet. This channel, though yet somewhat narrow, has afforded great relief to commerce. In the Pascagoula River three channels, with an aggregate length of 6,600 feet, have been excavated through as many bars to a width of 150 feet and a depth of 12 feet as projected, completing the work above railroad bridge at Scranton, Miss. Below the bridge, where the channel is to be 300 feet wide and 12 feet deep, one cut 200 feet wide has been excavated to the required depth for a distance of 7,935 feet, one cut 100 feet wide for a distance of 950 feet, and two cuts of 50 feet width for an aggregate distance of 12,540 feet.

Commercial statistics.

[Furnished by Pascagoula Commercial Club, Scranton, Miss.]

Vessels cleared.	1900.		1899.		1898.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Foreign	188	99,636	217	111,515	160	89,636
Domestic	38	12,276	36	12,827	61	24,178
Total	226	111,912	253	124,342	221	113,814

	Tons.	Value.
EXPORTS, FOREIGN.		
Lumber and timber	190,000	$1,138,000
EXPORTS, DOMESTIC.		
Lumber and timber	66,000	320,000
Rosin	7,500	150,000
Turpentine	2,250	225,000
Charcoal	10,000	50,000
Fish	150	10,000
Oysters	1,875	80,000
Wool	25	10,000
Total	277,800	1,983,000

July 1, 1899, balance unexpended		$49,396.17
Amount appropriated by sundry civil act approved June 6, 1900		267,600.00
		316,996.17
June 30, 1900, amount expended during fiscal year		43,160.78
July 1, 1900, balance unexpended		273,835.39
July 1, 1900, outstanding liabilities	$31,223.74	
July 1, 1900, amount covered by uncompleted contracts	242,611.65	
		273,835.39

(See Appendix T 7.)

8. *Chickasahay River, Mississippi.*—The original condition of this river was such that only small rafts could be brought down during high water, and it was troublesome and dangerous for them even then. The minimum width of the channel was 50 feet and minimum depth 6 inches, and it was filled with logs and snags.

The original project, that of 1890, was to obtain a high-water channel from the mouth up to Shubuta, Miss., 130 miles, by removal of obstructions and overhanging trees. The river and harbor act of June 3, 1896, modified this project and limited the improvement to that part of the river from the mouth to railroad bridge near Bucatunna, Miss., 75 miles.

The total amount expended on this improvement to June 30, 1899, was $17,567.74. The condition of the river at that time would permit of its navigation by small steamboats from the mouth to railroad bridge near Bucatunna, Miss., on a 4-foot rise, as projected, but the channel was more or less obstructed by the accumulation of snags, logs, and overhanging trees, which had not been removed for several years, except for a distance of about 20 miles from the mouth up.

Work during the past year has resulted in the removal of the accumulation of obstructions up to within about 15 miles of the railroad bridge near Bucatunna, Miss., the point reached when operations were suspended on account of lack of funds.

Commercial statistics.

[Approximate.]

Articles.	1900.	1899.	1898.
	Tons.	*Tons.*	*Tons.*
Logs and timber	100,960	90,960	22,320
Rosin	920	700	315
Turpentine	360	250	113
Grain and fertilizer			150
General merchandise	50		45
Staves	900	1,125	
Total	103,190	93,035	22,943

July 1, 1899, balance unexpended	$1,932.26
June 30, 1900, amount expended during fiscal year	1,832.33
July 1, 1900, balance unexpended	99.93
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 8.)

9. *Leaf River, Mississippi.*—The original condition of the channel of this river was such that navigation was impossible on account of logs, snags, and overhanging trees. The minimum width of the river was 100 feet and the minimum depth 2½ feet.

The original project was adopted in 1890, and was to afford a channel for high-water navigation from Bowie Creek to the river's mouth, 75 miles, by removal of obstructions and overhanging trees, at an estimated cost of $25,000. This project was completed in 1897 at a cost of $11,019.04. Work done since has been for maintenance.

The total amount expended on this improvement to June 30, 1899, was $15,219.51. The condition of the river at that time was such that light-draft boats and rafts of logs and timber could navigate the entire distance, though the channel was greatly obstructed by logs, snags, etc., except for about 15 miles above Hemphill's mill, from which obstructions were removed during May and June, 1898.

During the past fiscal year work was continued from Hemphill's mill downstream about 30 miles to a short distance above the mouth, leaving 45 miles of the river almost free from obstructions.

Commercial statistics.

[Approximate.]

Articles.	1900.	1899.	1898.
	Tons.	*Tons.*	*Tons.*
Logs and timber	71,000	66,000	96,360
Rosin	2,875	2,835	455
Turpentine	3,120	2,025	194
Grain and fertilizer			180
General merchandise	72		60
Total	77,067	70,850	97,249

July 1, 1899, balance unexpended	$2,280.49
June 30, 1900, amount expended during fiscal year	1,523.77
July 1, 1900, balance unexpended	756.72
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix T 9.)

10. Channel from Gulfport to Ship Island Harbor, Mississippi.—By the river and harbor act approved March 3, 1899, authority was granted to make a contract for dredging a channel to, and an anchorage basin at, Gulfport, Miss., at a cost not to exceed $150,000, and for the maintenance of this channel and basin for five years at a cost not to exceed $10,000 per year.

The text of the item in the act is as follows:

> Gulfport, Mississippi, to Ship Island Harbor: The Secretary of War is hereby authorized to enter into a contract or contracts to dredge a channel three hundred feet wide and nineteen feet deep at mean low water from the anchorage at Ship Island Harbor, on the Gulf of Mexico, to Gulfport, in Harrison County, in the State of Mississippi, and to construct at the end of said channel next the shore an anchorage basin of similar depth not less than two thousand six hundred and forty feet by one thousand three hundred and twenty feet in area, at a cost not to exceed one hundred and fifty thousand dollars; and the Secretary of War is further authorized to contract for the maintenance of said channel and anchorage basin for the term of five years after its completion for the sum of ten thousand dollars annually: *Provided*, That the necessary expenses for such examinations, surveys, and inspections of the work as may be required from time to time to determine whether the channel and anchorage basin are dredged and maintained as required by this act shall be paid from the permanent indefinite appropriation made by section four of the river and harbor act approved July fifth, eighteen hundred and eighty-four: *And provided further*, That the depths provided for shall be at mean low water as determined by the engineer officer in local charge of work.

Under the law, specifications were prepared and the work advertised, but no bids were received.

(See Appendix T 10.)

11. Ship Island Pass, Mississippi.—Under an act of Congress approved June 16, 1898, a survey was ordered to determine a plan and estimate for a channel 26 feet deep at mean low water through Ship Island Pass, Mississippi. This survey was made, and report with plan and estimate submitted to Congress and published in House Doc. No. 120, Fifty-fifth Congress, third session; it is also printed in the Annual Report of the Chief of Engineers for 1899, page 1787.

By the river and harbor act approved March 3, 1899, an appropriation of $40,000 was made for this improvement.

Under this appropriation contract was entered into, the work commenced November 23, 1899, and completed March 13, 1900, removing 163,401 cubic yards of material and making a channel 26 feet deep across the bar at Ship Island Pass.

The total amount expended on the improvement to June 30, 1899, was $378.70.

July 1, 1899, balance unexpended	$39,621.30
June 30, 1900, amount expended during fiscal year	39,018.44
July 1, 1900, balance unexpended	602.86

(See Appendix T 11.)

12. Mouth of Pearl River, Mississippi.—The depth of water over the channel way leading from the mouth of Pearl River to deep water in Mississippi Sound was about 7 feet.

It was proposed to dredge a channel at this place 100 feet wide and 12 feet deep at mean low water, at an estimated cost of $20,000 (see Annual Report of the Chief of Engineers for 1885, p. 1367), and this plan of improvement was adopted by act of Congress dated August 5, 1886. The river and harbor acts of August 11, 1888, and September 19, 1890, each appropriated $5,000 for dredging this channel. Proposals were advertised for, one being received and rejected as too high. The work was not again advertised, as the amount was considered too small to secure a favorable price.

Under the river and harbor act of June 3, 1896, a survey was ordered to determine a plan and estimate for a channel at the mouth of Pearl River leading to deep water in Mississippi Sound with a view to obtaining a 17-foot channel at low tide.

This survey was made, and report, together with plans and estimates, was submitted to Congress and published in House Doc. No. 206, Fifty-fourth Congress, second session; it is also printed in the Annual Report of the Chief of Engineers for 1897, page 1727. In submitting his report on this survey, the local officer gave as his opinion that this channel was not worthy of improvement to a greater depth than 9 feet, and estimated the cost of dredging a channel 300 feet wide and 9 feet deep at $18,199.80.

By river and harbor act of March 3, 1899, an appropriation of $18,199.80 was made to dredge a channel 300 feet wide and 9 feet deep. Under this appropriation a contract was entered into and dredging was commenced November 13, 1899, and continued to January 8, 1900, when available funds were exhausted, resulting in the removal of 63,531 cubic yards of material and giving a channel 9 feet deep and 160 feet wide. Under the project submitted for this work it was estimated that the removal of 60,666 cubic yards of material would afford a channel 9 feet deep and 300 feet wide, but this estimate was based on material in place and without allowing anything for back filling, and when dredging operations commenced the bar through which the cut was to be made was found to be larger than had been reported. Accordingly, upon the exhaustion of the appropriation of March 3, 1899, authority was requested and granted to apply balance of appropriations of 1888–1890, amounting to $9,945.35, to this work. Dredging was continued under these appropriations until February 5, 1900, removing an additional 33,169 cubic yards of material and completing the channel to a width of 300 feet with a depth of 9 feet at mean low water, as projected.

The amount expended on this improvement to June 30, 1899, was $216.85.

July 1, 1899, balance unexpended	$27,982.95
June 30, 1900, amount expended during fiscal year	27,496.23
July 1, 1900, balance unexpended	486.72

(See Appendix T 12.)

13. Pearl River, below Rockport, Miss.—This work was formerly reported on under the title of "Pearl River, below Jackson." An act of Congress approved April 21, 1900, authorized the construction of a drawbridge across the Pearl River at Rockport, thus virtually making Rockport, 246 miles from the mouth of the river and 69 miles below

Jackson, the head of navigation for the section of river below Jackson. The river and harbor acts of June 3, 1896, and March 3, 1899, limited the improvement to the section between Holmes Bayou and Monticello, Miss. The original condition of this river was such as to allow navigation only during high water, and then it was difficult and dangerous.

The first project was adopted in 1880, being for a 5-foot channel at low water, but this depth was found impracticable, and the project was modified in 1885 to provide for a 2-foot channel at low water.

The total amount expended on this improvement to June 30, 1899, was $148,641.86. The condition of the river at that date was such as to permit of its navigation from the mouth to Monticello, 211¾ miles, by boats of 3-foot draft or less all the year. From Monticello to Jackson, Miss., 101¼ miles, the river could and can yet be navigated only on a rise of 6 or 7 feet above low water.

From May 1, 1899, to January 15, 1900, 61 miles of river from the head of Holmes Bayou upstream was worked over, removing all obstructions accumulated since last work was done. The river is now navigable for boats of 3-foot draft from the mouth to Monticello, but is greatly in need of work through Holmes Bayou, where the channel is narrower and there are many snags, trees, and other obstructions in it.

Commercial statistics.

Articles.	1900.	1899.
	Tons.	*Tons.*
Saw logs, pine	28,896	26,074
Lumber	46,200	28,634
Staves	200	....
Total	75,296	54,708

July 1, 1899, balance unexpended		$6,483.14
June 30, 1900, amount expended during fiscal year		5,168.58
July 1, 1900, balance unexpended		1,314.56
July 1, 1900, outstanding liabilities		60.00
July 1, 1900, balance available		1,254.56
Amount (estimated) required for completion of existing project		33,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$10,000.00	
For maintenance of improvement	7,000.00	
		17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix T 13.)

14. *Pearl River, between Carthage and Jackson, Miss.*—The original condition of this part of the river was such as to render navigation impossible except during high water, and even then it was difficult and dangerous. The minimum width of the river was 100 feet and of the channel 40 feet; the minimum depth was about 1 foot.

The project for this work provides for securing and maintaining a channel 2 feet deep at low water.

The total amount expended on this improvement to June 30, 1899, including maintenance, was $35,969. The condition of the river at that time was such that light-draft boats could navigate from Carthage to Jackson on a 3-foot rise above ordinary low water, though the channel was more or less obstructed by snags, logs, etc., which had accumulated since the last work was performed.

Work of removing the annual accumulation of obstructions was commenced on July 15, 1899, and the entire stretch of river was worked over and funds practically exhausted by December 20, 1899, resulting in a maintenance of improvement.

July 1, 1899, balance unexpended	$2,581.00
June 30, 1900, amount expended during fiscal year	2,423.25
July 1, 1900, balance unexpended	157.75
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 14.)

15. Pearl River, between Edinburg and Carthage, Miss.—The original condition of this portion of the river was such that navigation at low water was impossible, and even during high water difficult and dangerous. The minimum width of the channel was 30 feet and the minimum depth of water about 3 inches.

The original project for this work was adopted in 1884, and was to afford a high-water channel from Edinburg to Carthage, 24¾ miles, during six or eight months of the year, and to maintain same at an annual cost of $500, by removal of obstructions and overhanging trees.

The total amount expended on this part of Pearl River to June 30, 1899, was $16,552.13. The condition of the river at that date was such as to allow navigation by light-draft boats on a 4-foot rise above ordinary low water.

During the past fiscal year only 5 miles of river was worked over, when operations had to be suspended on account of near exhaustion of funds, leaving the channel for that distance free of obstructions and overhanging trees.

July 1, 1899, balance unexpended	$697.87
June 30, 1900, amount expended during fiscal year	529.96
July 1, 1900, balance unexpended	167.91
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harber act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 15.)

16. Bogue Chitto, Louisiana.—The original condition of this stream rendered navigation impossible, except during very high water, owing to shoals and sand bars at the mouth, and snags, logs, and overhanging trees obstructing the channel above. The minimum width of the channel was 80 feet and the minimum depth 3 feet.

The project adopted in 1890 provided for securing a clear 3-foot channel from the mouth up to Alford's bridge, near Summit, Miss., 190 miles, by closing the west mouth of river, several run-out bayous, and removing obstructions and overhanging trees, at an estimated cost of $55,000.

The total amount expended on this improvement to June 30, 1899, was $20,789.74. The condition of the river at that time would permit of its navigation by light-draft boats for about 36 miles up from the mouth, navigation any higher up being safe only during high water.

Work during the past year was continued from West Bogue up to Cross River, 61 miles above the mouth of the river, leaving the channel for that distance about free from obstructions.

Commercial statistics.

Articles.	1900.	1899.	1898.
Logs and timber:	*Tons.*	*Tons.*	*Tons.*
Pine	17,000	14,000	8,457
Cypress	6,000	4,000	4,475
Total	23,000	18,000	12,932

July 1, 1899, balance unexpended	$4,210.26
June 30, 1900, amount expended during fiscal year	3,715.56
July 1, 1900, balance unexpended	494.70
July 1, 1900, outstanding liabilities	55.00
July 1, 1900, balance available	439.70
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	9,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T 16.)

17. *Removing sunken vessels or craft obstructing or endangering navigation.*—The schooner *Robert H. Rathburn*, loaded with lumber, was burned and sunk in Pascagoula Harbor, Mississippi, on the 20th day of May, 1898, and was reported as dangerous to navigation June 1, 1898. After advertisement, an oral agreement was made for removal of the wreck for $1,400. It has been entirely removed.

A wooden side-dump scow and a wooden barge were sunk in Mobile River opposite foot of Adams street, Mobile, Ala., some years ago (exact date unknown). Proposals were invited by advertisement for their removal. The lowest bid received was recommended for acceptance. In the meantime, Mr. B. Roberts, of Mobile, Ala., claimed the barge as his property, stating that he would remove the same, which he did. Readvertisement was made inviting proposals for the removal of the remaining side-dump scow. One bid was received and rejected as too high. The scow was subsequently removed under an oral agreement for $250.

(See Appendix T 17.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Mobile Harbor, Alabama, with a view to obtaining channels of a width of 300 feet at the bottom across the bar below Fort Morgan, with appropriate side slopes, and with mean depths of 25 and 30 feet, respectively.

2. Warrior and Tombigbee rivers, Alabama, with a view to the construction of locks and dams numbered 1, 2, and 3, between the mouth of said rivers and Tuscaloosa.

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

The inspecting officers during the year were Maj. James B. Quinn, Corps of Engineers, to December 1, 1899, and Maj. H. M. Adams, Corps of Engineers, since that date.

The act of Congress of March 3, 1875, amended by acts of June 19, 1878, and March 3, 1879, made provision for the construction, by James B. Eads or his representatives, of jetties and other works in South Pass of the Mississippi River, to secure and maintain a channel 26 feet in depth through the pass, and through the jetties at the mouth of the pass a channel "26 feet in depth, not less than 200 feet in width at the bottom, and having through it a central depth of 30 feet without regard to width." An annual payment of $100,000 was provided for the maintenance of such a channel for twenty years after first obtaining it by the works built. The required channels were secured in July, 1879.

The period of twenty years is exclusive of all periods of time during which the required channel was not maintained, and should the required channel be maintained from the present time until January 28, 1901, the contract will terminate with that date.

The required channel was maintained during the year throughout South Pass, except for one day. The required channel "through the jetties," and beyond them to deeper water in the Gulf, was maintained during the year, except for eighteen days.

During the year the dredge boat worked eight hundred and forty-three hours in the jetty channel, twenty hours in Grand Reach section of South Pass, and sixteen hours in the Gulf.

The object of the examination and survey of South Pass is to determine whether the channel is maintained as required by law and to enable an engineer officer to issue the certificates for the quarterly payments and "such other information as the Secretary of War may direct." The expenses of this work are now provided for by a permanent appropriation made by act of August 11, 1888.

The emergency river and harbor act of June 6, 1900, provides as follows:

> SEC. 3. That the Secretary of War is hereby authorized, in his discretion, to terminate the contract heretofore entered into with the late James B. Eads for the maintenance of the channel through the South Pass of the Mississippi River, in pursuance of an Act of Congress approved March third, eighteen hundred and seventy-five, entitled "An Act authorizing James B. Eads and others to construct jetties, and so forth, and to maintain channels between South Pass of Mississippi River and Gulf of Mexico," and of an Act of Congress approved June nineteenth, eighteen hundred and seventy-eight, entitled "An Act to amend an Act entitled 'An Act making appropriations for the repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes.'" approved March third, eighteen hun-

dred and seventy-five, and of an Act of Congress approved March third, eighteen hundred and seventy-nine, entitled "An Act to amend an Act entitled 'An Act making appropriations for the repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes,'" approved March third, eighteen hundred and seventy-five. The Secretary of War is also authorized, in his discretion, to purchase from the heirs or legal representatives of the said James B. Eads the dredges and other plant including real estate now used by them for the maintenance of said channel, or such portion of said plant as he may deem desirable; and in case the Secretary of War and the heirs or legal representatives of the estate of James B. Eads, deceased, are unable to agree upon the price to be paid for said dredges and plant, including real estate, or so much thereof as the Secretary of War may deem necessary to purchase, then such price shall be assessed by a board of three appraisers to be appointed as follows: One appraiser to be appointed by the Secretary of War, one by the heirs or legal representatives of James B. Eads, deceased, and in case these two fail to agree, they shall jointly choose a third appraiser, and the three so appointed shall, by a majority vote, duly appraise the price to be paid for said dredges and plant, including real estate, and in case such appraisal is approved by the Secretary of War, the same shall be deemed to be the price which the Secretary of War is authorized to pay for said dredges and plant including real estate or so much thereof as the Secretary of War may deem necessary to purchase: *Providing*, That in no event shall more than two hundred thousand dollars be paid for all the dredges, plant and real estate owned or possessed by the heirs or legal representatives of James B. Eads, deceased, at or about the South Pass. And in case the Secretary of War shall terminate said contract the sum of two hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be immediately available, for the purchase of the whole or a part of said plant, or for otherwise providing a proper plant for the maintenance of said Pass. In case of the termination of said contract, by virtue of the provisions hereof or by expiration of said contract the Secretary of War is hereby directed to take charge of said channel, including the jetties, and all auxiliary works connected therewith, and thereafter to maintain with the utmost efficiency said South Pass Channel; and for that purpose he is hereby authorized to draw his warrants from time to time on the Treasurer of the United States, until otherwise provided for by law, for such sums of money as may be necessary, not to exceed in the aggregate for any one year one hundred thousand dollars. In the event that the Secretary of War shall elect to terminate said contract, any sum which shall at that time have been appropriated by Congress to pay what would be due to the heirs or legal representatives of said James B. Eads at the expiration of said contract may be used by him in making such payment, when he shall terminate the same, anything in the law making such appropriation to the contrary notwithstanding.

The matter is having the consideration of the Secretary of War.

The annual report of Major Adams is submitted herewith as Appendix U.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN LOUISIANA AND EASTERN TEXAS, AND OF HOMOCHITTO RIVER, MISSISSIPPI.

This district was in the charge of Maj. James B. Quinn, Corps of Engineers, to November 30, 1899, and of Maj. H. M. Adams, Corps of Engineers, since that date, the officer in charge having under his immediate orders Lieut. Clarke S. Smith, Corps of Engineers, to August 10, 1899. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Chefuncte River and Bogue Falia, Louisiana.*—Chefuncte River is tributary to Lake Pontchartrain and is entered by the Bogue Falia about 10 miles from its mouth. An examination in 1879 showed that the Chefuncte was practically not navigable above the junction with the Bogue Falia, while the latter stream was navigable by sailing vessels to Covington, a distance of 16 miles from its mouth, and by small steamers to Grants Landing, 2 miles below Covington. In their original condition these streams were obstructed by snags, logs, and overhanging trees, and a bar existed at the mouth of the Chefuncte over which there was a depth of 4½ feet during low water. The whole of

Chefuncte River, inside of this bar, from the mouth to Bogue Falia, constituted a harbor with a width varying from 300 to 800 feet and a depth of 15 feet. In Bogue Falia the depth was 5½ feet.

In 1880 a project was adopted which provided for dredging the bar at the mouth of the Chefuncte and the removal of obstructions from this point to Covington, on the Bogue Falia, the estimated cost of which was $5,460. This project was modified in 1884 to provide for building a breakwater 820 feet long over the bar at the mouth of the river, at a cost of $1,500.

Under these projects the work of improvement and maintenance has been carried on since 1880, the breakwater being constructed in November, 1884.

The amount expended on the improvements to June 30, 1899, was $8,439.33. On that date the depth over the bar at the mouth of the Chefuncte had shoaled to 4 feet at low water, and several bars existed in the Bogue Falia, near Covington.

With $2,000 appropriated in 1896 and 1899 the work of maintenance was carried on during the past fiscal year under project approved March 24, 1899. The bar at the mouth of Chefuncte River was dredged to a depth of 6 feet and a width of 60 feet; several shoals and a number of obstructions were removed from Bogue Falia. The Chefuncte River, inside the bar, has ample depth as far as Bogue Falia, and this latter stream is navigable by vessels drawing 5½ feet up to Grants Landing and for sailing vessels up to Covington. The streams are free from obstructions between the mouth of the Chefuncte and Covington, but the improvement is not permanent, as obstructions continue to form.

Comparative statement of receipts and shipments for ten years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1891	45,521	$201,061	....
1892	50,054	354,684	4,533
1893	30,284	429,126	....
1894	242,464	919,699	212,180
1895	49,778	350,111	....
1896	67,680	621,454	17,902
1897	110,034	632,894	42,354
1898	99,505	723,833	....
1899	97,789	732,893	....
Calendar year 1899	156,500	673,000	58,711

July 1, 1899, balance unexpended	$2,060.67
June 30, 1900, amount expended during fiscal year	1,915.69
July 1, 1900, balance unexpended	144.98
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V 1.)

2. *Tickfaw River and its tributaries, Louisiana.*—Tickfaw River is tributary to Lake Maurepas. Prior to improvement, this stream and its navigable branches, the Natalbany, Blood, and Ponchatoula rivers, were obstructed by logs, snags, and trees.

The original project for improvement, adopted in 1881, provided for the removal of obstructions as far as appropriations would permit, at an estimated cost of $10,230. Work under this project was carried on from 1881 to 1895, with appropriations aggregating $10,000. About 30 miles of the Tickfaw and its tributaries were improved, and the commerce of the rivers was increased.

With the $1,000 appropriated by act of June 3, 1896, about 2 miles of Tickfaw River, near its mouth, was cleared of water hyacinths, but the plants accumulated again, impeding navigation as before.

The amount expended on this improvement up to June 30, 1899, was $10,893.67.

At the beginning of the past fiscal year the Tickfaw and Natalbany rivers were obstructed by snags, overhanging trees, and water hyacinths, and a bar had formed at the mouth of the Tickfaw; the Blood and Ponchatoula rivers were in fair condition.

Act of March 3, 1899, appropriated $1,000 for maintenance, and the work of removing obstructions was carried on, under contract, from August 7 to September 9, 1899. The bar at the mouth of Tickfaw River was removed and the channel cleared of obstructions for a distance of 13 miles from its mouth. Obstructions were also removed from the mouth of Natalbany River.

The streams are now in fair condition, except for water hyacinths, which accumulate very rapidly. The improvement is not considered permanent, as obstructions continue to form.

Tickfaw River has a navigable depth of 6 feet for 30 miles from its mouth, and Natalbany has a like depth for 12 miles from its mouth. The Blood and Ponchatoula rivers are used principally for floating logs.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1893	13,994	$169,643	
1894	40,003	251,774	26,009
1895	23,384	220,566	
1896	72,851	353,246	48,467
1897	58,115	336,370	
1898	75,579	436,388	17,464
1899	52,961	338,423	
Calendar year 1899	79,300	649,600	26,339

July 1, 1899, balance unexpended	$1,106.33
June 30, 1900, amount expended during fiscal year	1,020.63
July 1, 1900, balance unexpended	85.70
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V 2.)

3. *Amite River and Bayou Manchac, Louisiana.*—Amite River is tributary to Lake Maurepas, and Bayou Manchac is the principal tributary of Amite River, emptying into it about 36 miles from the mouth. Prior to improvement these streams were obstructed by snags and overhanging trees. The Amite River was navigable by small steamers for about 45 miles from its mouth, and Bayou Manchac for a distance of 10 miles, but such navigation was attended with danger.

The original project, adopted in 1880, provided for clearing obstructions from Amite River above Bayou Manchac as far as appropriations would permit, so as to obtain a channel of navigable width and 5-foot depth at low water, at a cost of $23,760. In 1883 the project was modified so as to extend the work from Bayou Manchac to Lake Maurepas, at an additional cost of $8,000. The improvement of Bayou Manchac was added by Congress in 1888 and a project for the removal of obstructions was approved September 7, 1888.

The work of improvement and maintenance, under these projects, was carried on to May 31, 1895, from the mouth of Amite River for a distance of 42 miles, and in Bayou Manchac to Wards Creek, a distance of 10 miles from its mouth. A turning basin for boats, authorized by act of 1892, was made at the mouth of Wards Creek.

The sum of $28,618.77 was expended on these improvements up to June 30, 1899. At that time navigation had become dangerous by reason of obstructions which had formed in the streams since 1895, and sand bars which had formed at the mouths of Amite River and Bayou Manchac.

With appropriations of $2,500 made June 3, 1896, and $2,500 made March 3, 1899, maintenance of the improvement was carried on under contract from November 15, 1899, to March 16, 1900. The sand bars at the mouths of these streams were removed, and shoal places in Bayou Manchac were dredged. Obstructions in both streams were removed as far as the available funds would allow. The cost of these improvements was $4,966.18.

The Amite River now has a navigable channel 60 feet wide and 5 feet deep for a distance of 42 miles from the mouth, and Bayou Manchac is navigable for 10 miles from its mouth for vessels drawing 5 feet.

Comparative statement of receipts and shipments for ten years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1891	17,792	$300,963	....
1892	18,530	334,061	738
1893	22,099	346,257	3,569
1894	157,902	796,805	135,803
1895	42,983	491,216	....
1896	55,103	414,245	12,120
1897	49,509	516,443	....
1898	54,749	516,477	5,240
1899	60,305	893,121	5,556
Calendar year 1899	59,850	1,166,142	....

July 1, 1899, balance unexpended	$5,181.23
June 30, 1900, amount expended during fiscal year	4,966.18
July 1, 1900, balance unexpended	215.05
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V 3.)

4. *Closing crevasse in Pass a Loutre, Mississippi River.*—Pass a Loutre is one of the three outlets of the Mississippi River. The crevasse forms an outlet from Pass a Loutre into an arm of the gulf known as Garden Island Bay, and was caused by the wearing away of the south bank of that pass at a locality 1¾ miles below Head of Passes.

The ditch where the crevasse first broke was 3 feet wide in 1872, and gradually increased from year to year. In January, 1891, the crevasse began to widen rapidly, but could not be checked on account of high water in the river. In July, 1891, it was 860 feet wide and 25 feet deep. Several attempts were made near this time by the estate of James B. Eads to close the crevasse, but it seemed a hopeless task and was abandoned. On November 18, 1896, the crevasse was 2,230 feet wide, and on February 26, 1897, Congress appropriated $250,000 for the closure.

The project approved July 10, 1897, provided for building a dam 6,650 feet long, in two sections, 1,900 and 4,750 feet long, respectively, forming an angle of 112° at a distance of 3,000 feet below the mouth of the crevasse, the dam to be constructed of Wakefield sheet piling backed with a double row of piles securely braced and bolted to stringers and the sheet piling, using a third row of brace piles where the depth of water exceeded 20 feet.

Under this project a contract for the work was approved December 10, 1897. Work was carried on from December 14, 1897, to January 27, 1898, and from August 5, 1898, to November 13, 1898. On the last-named date the work was considered completed and was accepted. At that time it seemed that the closure would prove a permanent success, notwithstanding the high stage of the river. A severe storm arose that night and on November 14 the dam gave way in two localities and 170 feet of it washed out. From time to time since then the break in the dam has widened, and on June 30, 1900, it was 678 feet, 36 feet being lost within the past year.

On February 17, 1898, Congress allotted $10,000 from this appropriation for the expenses of a survey and report by a Board of Engineer Officers upon the practicability of securing a channel of adequate width and of 35 feet depth at mean low water of the Gulf of Mexico throughout Southwest Pass, Mississippi River. The survey was completed in 1898 and report submitted on January 7, 1899. This report is printed in House Doc. No. 142, Fifty-fifth Congress, third session, and in the Annual Report of the Chief of Engineers for 1899, as Appendix U 19.

The amount expended from this appropriation up to June 30, 1899, was $227,256.86, of which $6,723.78 was for the survey of Southwest Pass.

No work toward closing the crevasse was attempted during the past year, the amount available being insufficient for the purpose. An inspector and watchman were kept at the dam for part of the year to report the conditions.

July 1, 1899, balance unexpended	$22,743.14
June 30, 1900, amount expended during fiscal year	734.64
July 1, 1900, balance unexpended	22,008.50

(See Appendix V 4.)

5. *Improving outlet of the Mississippi River.*—The river and harbor act of March 3, 1899, appropriated $200,000 for constructing a sill

across Pass a Loutre and for constructing and operating two dredges for improving the outlet of the Mississippi River. The act further provided that a continuing contract may be entered into for these improvements, not to exceed $300,000, exclusive of the amount therein appropriated.

The item in the act is as follows:

> Improving outlet of the Mississippi River by constructing a sill across Pass a Loutre and by constructing and operating two dredges, two hundred thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry on such improvements, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate three hundred thousand dollars, exclusive of the amount herein appropriated. A board of four engineers shall be appointed by the President, of whom at least two shall be from civil life, who shall prepare and report, as soon as conveniently may be done, a project for securing a navigable channel of suitable width and of thirty-five feet depth at mean low water of the Gulf of Mexico throughout the Southwest Pass of the Mississippi River; said board of engineers shall submit detailed estimates of the cost of each and every feature of the project, and they shall report especially whether it is necessary to construct inner jetties; and if, in their judgment, inner jetties should be constructed, they shall provide for the location of the same, so as to involve the least cost consistent with the safety and efficiency of the work hereby contemplated. The sum of twenty thousand dollars, or so much thereof as may be necessary, is hereby appropriated to defray the cost of said board and of the preparation of said project.

It not being practicable to construct two hydraulic dredges of sufficient capacity for the desired work within the limit of cost fixed by the above-mentioned law, Congress provided in the emergency river and harbor act of June 6, 1900, as follows:

> Outlet of Mississippi River: Section one of the Act entitled "An Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," approved March third, eighteen hundred and ninety-nine, be, and the same is hereby, amended as follows: In the paragraph beginning "Improving outlet of the Mississippi River," strike out the word "two" before the word "dredges" and insert in lieu thereof the words "one or more."

The sundry civil act of June 6, 1900, also contained the following legislation affecting this work, viz:

> The Secretary of War is hereby authorized and empowered, in his discretion, in case any unusual obstruction to navigation in the channel of South Pass, Mississippi River, should occur during the fiscal year nineteen hundred and one, to use any dredges or tug boats of the Mississippi River Commission for the purpose of removing the same. And the sum of twenty-five thousand dollars, or so much thereof as may be necessary, is hereby appropriated, to be expended in the discretion of the Secretary of War in improving or altering such dredge or dredges so as to make the same available for use in said South Pass.
>
> * * * * * * *
>
> Improving Passes of the Mississippi River: For completing improvement by constructing sill across Pass a Loutre and by constructing and operating one or more dredges, three hundred thousand dollars.

On September 23, 1899, the Secretary of War approved a project covering the $200,000 appropriated by the act of March 3, 1899, which provides for the allotment of $50,000 for sill construction and $150,000 for dredges and for the construction of a mattress sill, weighted with stone, across the head of Pass a Loutre. Bids for the sill construction were opened on March 7, 1900, and on March 26 the lowest bid, at a total estimated cost of $171,402.65, was accepted. A contract has been entered into, and the work was commenced July 1, 1900.

A project for the expenditure of the appropriation of $300,000, made by the sundry civil act of June 6, 1900, for completing the improvement of the passes of the Mississippi River by constructing a sill across Pass a Loutre, and by constructing and operating one or more dredges, was approved by the Secretary of War July 2, 1900, and provides for an allotment of $125,000 for completion of the sill and $175,000 toward the construction of one dredge.

The work of sill construction is reported on by the officer in local charge, in Appendix V 5 herewith.

Several other hydraulic dredges being provided for by the river and harbor act of March 3, 1899, the whole subject of plans and specifications was placed under the supervision of one officer. Plans and specifications for a seagoing hydraulic dredge, estimated to cost $325,000, have been prepared, and bids for such dredge will be called for in the near future.

The law of March 3, 1899, contemplates the construction of two dredges, and plans for the second dredge are being prepared, but its construction can not be provided for until a further appropriation is made by Congress. No estimate for such second dredge is submitted, however, as the total amount authorized by the act of March 3, 1899, has been appropriated, and the question of an appropriation for the second dredge will be before Congress in connection with the report of the Board of Engineers regarding Southwest Pass (referred to below).

It is not probable that any action will be recommended under the provisions of law authorizing the alteration and use of dredges and tugboats of the Mississippi River Commission, unless an extreme emergency should arise. Even with such alterations as are practicable, the dredges would not be especially adapted to working in even a partially exposed location.

The Board of Engineers appointed to prepare and report a project for securing a channel of 35 feet depth through Southwest Pass to the Gulf submitted a report thereon January 11, 1900. The report was transmitted to Congress, and is printed in House Doc. No. 329, Fifty-sixth Congress, first session. It is also herewith as Appendix V 21.

July 1, 1899, balance unexpended		$200,000.00
Amount appropriated by sundry civil act approved June 6, 1900		300,000.00
		500,000.00
June 30, 1900, amount expended during fiscal year		1,153.74
July 1, 1900, balance unexpended		498,846.26
July 1, 1900, outstanding liabilities	$225.26	
July 1, 1900, amount covered by uncompleted contracts	171,402.65	
		171,627.91
July 1, 1900, balance available		327,218.35

(See Appendix V 5.)

6. *Bayou Lafourche, Louisiana.*—Bayou Lafourche is an outlet of the Mississippi River, forming a junction 70 miles above New Orleans. It is about 105 miles long, and flows into the Gulf of Mexico. In its original condition it was obstructed by logs, snags, and overhanging trees. The project of 1879 provided for the removal of such obstructions to improve low-water navigation. Work under this project was carried on until 1885, with appropriations aggregating $30,000.

The project of June 11, 1886, provided for the construction of a lock to connect the bayou with the Mississippi River, and for dredging a channel 75 feet wide and 5 feet deep at mean low water of the Gulf, at an estimated cost of $450,000, and $8,000 annually thereafter for maintenance. Work under this project was confined to dredging to maintain low-water navigation, the appropriations at any one time being insufficient to warrant the commencement of the lock, and the exigencies of commerce not permitting a suspension of the dredging.

The project of 1886 was modified on September 23, 1896, and held in abeyance the construction of the lock, restricting operations to dredging to maintain low-water navigation, at an estimated cost of $25,000 per annum.

The project of July 11, 1895, for the expenditure of $40,000 appropriated August 18, 1894, recommended that $30,000 be reserved for the purchase of a dredge whenever it became advisable to make such purchase.

Dredging operations, under the modified project of 1896, were carried on in 1897 and 1898 from the head of the bayou to about 3 miles below Thibodaux, improving about 38 miles of channel. This improvement is not permanent, as sand bars form each year after the subsidence of floods in the Mississippi River.

The amount expended on this work up to June 30, 1899, was $219,092.83. At that date the bayou was navigable only by flatboats drawing 18 inches of water, it being low-water season, but during the prevalence of high water large steamboats could navigate it.

The project of July 11, 1895, so far as the reservation of $30,000 for purchase of a dredge is concerned, was modified on December 7, 1899, to allow the expenditure of $9,000 of this amount in dredging to maintain flatboat navigation during low water. With these funds and the $7,500 appropriated March 3, 1899, dredging was carried on from August 9, 1899, to January 22, 1900. A number of sand bars and other obstructions were removed, and a depth of 3 feet during low water was secured from the head of the bayou at Donaldsonville to a point 8 miles below.

More obstructions having formed, the project of July 11, 1895, was further modified on May 11, 1900, to allow the expenditure of funds remaining to the credit of this appropriation in dredging during the low-water season. It is expected that this work will soon commence.

The conditions existing in the bayou at this time are the same that prevailed on June 30, 1899. Steamboats ply the stream for about eight months of each year, but during the remaining months the commerce is carried by flatboats from the Mississippi River. The width of the bayou at low water is about 60 feet; the navigable depth is 18 inches.

Comparative statement of receipts and shipments for ten years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1891	217,273	$8,244,225	
1892	171,885	5,660,662	
1893	212,476	7,422,285	40,591
1894	273,686	8,842,942	61,210
1895	263,607	9,224,554	
1896	229,891	5,629,237	
1897	217,292	4,988,875	
1898	269,398	7,367,783	52,106
1899	206,516	6,553,864	
Calendar year 1899	157,258	5,436,250	

July 1, 1899, balance unexpended	$33,407.17
June 30, 1900, amount expended during fiscal year	11,498.88
July 1, 1900, balance unexpended	21,908.29
July 1, 1900, outstanding liabilities	15.74
July 1, 1900, balance available	21,892.55

(See Appendix V 6.)

7. *Bayou Plaquemine, Grand River, and Pigeon bayous, Louisiana.*—Prior to 1867 the largest steamboats could pass through Bayou Plaquemine into Grand Lake and other connecting water routes, but at that time the police jury of Iberville Parish closed the bayou by means of a dam, shutting out the waters of the Mississippi. Grand River and Pigeon Bayous were obstructed by snags, logs, overhanging trees, and sand bars.

The present project is based upon legislation by Congress, according to project and estimate submitted February 11, 1887, and provides for dredging a channel in Bayou Plaquemine 60 feet wide and 6 feet deep from deep water up to the Plaquemine Dike, constructing a lock to connect the bayou with the Mississippi River, securing the mouth of the bayou from further caving, and removing obstructions from Grand River and Pigeon Bayous; total estimated cost, $1,708,250.

The protection of the bank of the Mississippi River at the mouth of the bayou was added to the improvement in 1888, and in act of July 13, 1892, the improvement of Grand River and Pigeon Bayous was also incorporated.

The act of June 3, 1896, authorized continuing contracts to be entered into to complete the project of improvement, not to exceed $1,173,250, exclusive of the amounts therein and previously appropriated.

The project of 1887 was modified on April 10, 1899, to allow for dredging Bayou Plaquemine to a depth of 10 feet and a width of 125 feet.

Dredging was carried on in Bayou Plaquemine in 1890, 1891, 1892, and 1894, resulting in securing a channel 6 feet deep and 60 feet wide from the mouth to the railroad bridge.

An allotment of $75,000 was made from the appropriation of 1888 for securing the bank of the Mississippi River at the head of the bayou. Five submerged spur dikes, placed at intervals of about 900 feet, with intervals protected by revetment, were completed in 1894. These dikes and revetments form a continuous protection 1,400 feet long below the site of the lock and 1,200 feet above, with an interval of 500 feet opposite the lock site, left for excavating the necessary channel to the lock.

In 1893, 1894, and 1897 obstructions were removed from the mouth of Bayou Sorrel and down Grand River through Pigeon Bayou to Grand Lake, a distance of 30 miles. Flat Lake, at the mouth of Grand River, was dredged in 1893 and 1897.

With funds appropriated in 1894 the work of constructing a cofferdam, excavating and driving a pile foundation for the lock, was carried on from 1895 to 1898, and completed.

In 1891 a project for the construction of a lock was submitted, but the funds available were insufficient to warrant its commencement at that time. The Board of Engineer Officers appointed to prepare plans and specifications estimated the cost of the lock at $700,000. Revised plans and specifications for the construction of the lock and approaches were approved October 27, 1897, and December 2, 1897, respectively, and a continuing contract for the work was entered into May 28, 1898, and approved June 17, 1898. The work was commenced in August, 1898.

The sum of $475,806.63 was expended on these improvements up to June 30, 1899. At that time work on the lock was in progress, the lock pit having been cleared of earth that had caved in since 1897, and part of the concrete floor having been laid. Bayou Plaquemine had a depth of 6 feet and a width of 60 feet from the mouth to the railroad bridge, and some obstructions existed in the bayou below that point. Grand River was also obstructed by sand bars, snags, and overhanging trees.

During the past year the contractors for the lock have completed the concrete floor and built up the walls to a height of 19 feet above the top of the floor. The 5 miter sills were completed, the inlet pipes and 18 snubbing hooks placed. Some extra piling was driven at the river end of the lock to strengthen the foundation, and the alignment of the sheet piling was restored.

A continuing contract for the construction of the power house and operating machinery for the lock, for $114,000, was entered into November 18, 1899, and was approved December 30, 1899.

A contract for the rectification of Bayou Plaquemine was entered into July 15, 1899, and work has been carried on since October 29, 1899. A narrow strip of land at Dardennes Bend, 5 miles from the railroad bridge, was purchased for $1,230, and a cut was made through the point to avoid the sharp turn of the bayou at the bend. About one-fourth of the work provided for under the contract has been completed to the required depth of 10 feet and width of 125 feet.

The work of dredging and removing obstructions from Grand River has been carried on under contract since November 25, 1899. Bayou Plaquemine was cleared of the largest bars and other obstructions from Dardennes Bend to Grand River, and obstructions in Grand River were removed from the mouth of Bayou Plaquemine to Pigeon Bayou, a distance of 25 miles. No work has been done on Upper Grand River.

During high water there is a depth of from 10 to 12 feet in these streams, but during low water there is only a depth of 4 feet in Bay Natchez, an enlargement of Grand River, and 4½ feet in Flat Lake, at the mouth of Grand River.

Comparative statement of receipts and shipments for nine years.

For year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1892	131,875	$1,343,608	....
1893	78,756	1,174,750	....
1894	133,752	555,677	54,996
1895	120,542	1,110,130	....
1896	92,379	284,175	....
1897	57,055	209,586	....
1898	76,626	138,708	19,571
1899	89,301	173,262	12,675
Calendar year 1899	111,750	450,000	22,449

July 1, 1899, balance unexpended		$754,193.37
Amount appropriated by sundry civil act approved June 6, 1900		200,000.00
		954,193.37
June 30, 1900, amount expended during fiscal year		195,437.42
July 1, 1900, balance unexpended		758,755.95
July 1, 1900, outstanding liabilities	$57,774.36	
July 1, 1900, amount covered by uncompleted contracts	544,236.20	
		602,010.56
July 1, 1900, balance available		156,745.39
Amount (estimated) required for completion of existing project		210,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		210,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix V 7.)

8. *Bayou Courtableau, Louisiana.*—Bayou Courtableau lies within the Atchafalaya Basin, and is tributary to the Atchafalaya River. Prior to improvement the Atchafalaya River had formed a large deposit of sand, known as Little Devil Bar, at the mouth of Bayou Courtableau. It was proposed by the project of 1880 to improve the bayou below Port Barre by closing some of the run-out bayous, in order to confine the water in the Courtableau, and to wash out the bar with the increased current; after this was accomplished, to construct a timber lock and dam to provide slack-water navigation to Washington, La., a distance of 28 miles. The estimated cost of the improvement was $40,000. The project was modified in 1883 to provide for the construction of a masonry, instead of timber, lock, increasing the original estimate to $78,500.

With appropriations aggregating $36,200, work was carried on under this project to 1895. The larger run-out bayous were closed with dams, and the increased current was effective in the partial removal of the bar. The dams were broken from time to time, and the bar at the mouth of the bayou formed again. The dams were repaired in 1891 and subsequent years. The construction of a lock has not been commenced, as it is believed that it will not be of benefit until the bar at the mouth is permanently removed.

During the high water of 1896, a large accumulation of logs formed at the neutralization point of the bayou current and the backwater of the Atchafalaya. The raft rapidly increased in size and density until in 1899 it was about 3 miles long and completely obstructed navigation.

An appropriation of $2,500 was made June 3, 1896, but the amount was insufficient for the removal of the raft, and it was held for increase.

The sum of $35,688.14 was expended on this improvement up to June 30, 1899. On that day the log raft still existed, and the bar at the mouth of the bayou had re-formed.

Act of March 3, 1899, appropriated $20,000 for the removal of the raft and preventing its re-formation. The project approved April 7, 1899, provided for removing the log raft to restore navigation, and to construct a floating boom across the mouth of the bayou to prevent the entrance of drift from the Atchafalaya River.

During the past year the raft was removed, the logs being drifted down the run-out bayous, and a channel from 60 to 110 feet wide was secured. A log boom, floating between piles, was constructed at the mouth of the bayou. It was found that a heavy deposit of sediment had been made under parts of the raft, but since the channel was cleared some of this sediment has been washed out by the current.

No dredging was done on the bar at the mouth of the bayou during the past year. Several of the dams built to close the run-out bayous are broken. The bayou is not navigable except during high water, when small steamers can pass over the bar.

Comparative statement of receipts and shipments for seven years.

Year ending May 31—	Tons.	Value.
1890	35,867	$4,629,584
1891	32,618	3,917,344
1892	20,041	994,471
1893	14,848	677,529
1894	9,195	485,811
1895	4,095	160,787
1896	1,994	103,944

There has been no commerce on Bayou Courtableau since 1896 on account of a portion of the stream being jammed with logs.

July 1, 1899, balance unexpended	$23,011.86
June 30, 1900, amount expended during fiscal year	20,140.74
July 1, 1900, balance unexpended	2,871.12
July 1, 1900, outstanding liabilities	522.33
July 1, 1900, balance available	2,348.79

(See Appendix V 8.)

9. *Bayou Teche, Louisiana.*—Bayou Teche is an important commercial stream of southern Louisiana, and finds its outlet into the Gulf of Mexico through Atchafalaya River. Prior to improvement it had a depth of 8 feet to St. Martinsville, La., but navigation was rendered dangerous by numerous obstructions. Above St. Martinsville the bayou was navigable by steamboats during high water. The project of 1870 provided for the removal of obstructions from the head to the mouth of the bayou. Work under this project was carried on from 1870 to 1886, the stream being cleared of logs, snags, wrecks, overhanging trees, and a number of sand bars. The improvement was not permanent, and other obstructions formed.

The project of 1891 provided for the removal of obstructions between St. Martinsville, La., and the mouth of the bayou, a distance of about 80 miles. Work under this project has been carried on since 1891, obstructions being removed as appropriations were made.

The amount expended on these improvements to June 30, 1899, was $70,695.07. At that time it was found that the depth of water in the bayou had maintained itself, no new bars having formed, but numerous obstructions, such as sunken logs and wrecks of coal barges, had lodged in the bayou, endangering navigation.

Act of March 3, 1899, appropriated $10,000 for continuing the improvement. During the past year snagging operations were carried on from St. Martinsville, La., to the mouth of the bayou, resulting in the removal of a number of wrecks and other obstructions. The stream was left in better condition than it has been for some years. It has a navigable depth of 7 feet from the mouth to Franklin, 6 feet from Franklin to New Iberia, and 5 feet from New Iberia to St. Martinsville, La. During ten months of the year vessels drawing 5 feet can go 35 miles above St. Martinsville, and in flood seasons the bayou is navigable to its head.

Comparative statement of receipts and shipments for nine years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1892	64,866	$833,110	....
1893	115,080	5,754,542	50,214
1894	383,154	7,378,789	268,074
1895	279,928	5,794,483	....
1896	293,685	4,269,695	13,757
1897	303,029	4,103,724	9,344
1898	238,783	5,253,067	....
1899	286,091	5,251,590	47,308
Calendar year 1899	272,975	2,744,012	....

July 1, 1899, balance unexpended	$10,304.93
June 30, 1900, amount expended during fiscal year	9,850.74
July 1, 1900, balance unexpended	454.19
July 1, 1900, outstanding liabilities	190.00
July 1, 1900, balance available	264.19
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	7,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V 9.)

10. Channel, bay, and passes of Bayou Vermilion, Louisiana.—Before any improvement was attempted the upper 12 miles of Bayou Vermilion had a depth of only 2 feet, but below this the depth was not less than 5½ feet through the bayou, bay, and passes, with a width of from 100 to 400 feet. The channel was also obstructed by snags, logs, and overhanging trees.

The original project of 1892 provided for the removal of these obstructions and the erection of guide piles to mark the channel over the bars in Vermilion Bay and provided for a depth of 5½ feet of water up to the railroad bridge near Lafayette, La., a distance of 50 miles, at an estimated cost of $25,000.

With appropriations aggregating $12,500 the removal of obstructions was carried on in 1892, 1893, and 1895, and the stream placed in navigable condition to Broussards Bridge, a distance of 34 miles from the mouth. The guide piles were driven in Vermilion Bay in 1893.

Act of June 3, 1896, appropriated $1,000 for continuing the improvement, but the amount was insufficient to cover the work required and was held for increase.

The sum of $12,479.22 was expended on this improvement to June 30, 1899. On that date the bayou between Broussards Bridge and the railroad bridge, a distance of 16 miles, was unimproved, and obstructions had again formed from Broussards Bridge to Abbeville, a distance of 14 miles.

The appropriation of 1896 was augmented by one of $2,500 made March 3, 1899. With these funds work was carried on from November 8, 1899, to February 3, 1900, and the stream cleared of obstructions from Abbeville, La., to the railroad bridge. The improvement is not permanent, however, as obstructions continue to form.

The bayou is now navigable for a distance of 30 miles from the mouth by vessels drawing 5½ feet, and from that point to the railroad bridge it has a navigable depth of 2½ feet.

Comparative statement of receipts and shipments for seven years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1894	43,822	$923,777	
1895	12,993	429,172	
1896	13,022	355,136	29
1897	6,126	282,892	
1898	8,862	314,615	2,736
1899	14,969	320,339	6,107
Calendar year 1899	7,650	404,480	

July 1, 1899, balance unexpended	$3,520.78
June 30, 1900, amount expended during fiscal year	3,513.31
July 1, 1900, balance unexpended	7.47

Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix V 10.)

11. Mermentau River and tributaries, Louisiana.—A survey of Mermentau River and its tributaries in 1891 showed depths varying from 7 to 30 feet, through Grand Lake 6 feet and below Grand Lake 30 feet, diminishing to a depth of 13 feet at the mouth. At the head of the lake, 5 miles above the mouth of the river, was a channel through the shoal 7 feet deep, available for steamers but too crooked for sailing vessels. The streams were also obstructed by snags, logs, etc. The width varied from 70 feet at Vitorborville to 250 feet at the mouth of the Nezpique; from thence to Lake Arthur the average width was 350 feet.

The original project of 1892 contemplated the removal of obstructions in the upper river and of a mud flat in the lower part; brush wing dams to be used in the removal of the flat. The cost was estimated to be $23,615.25.

With an appropriation of $7,500 made in 1892 snagging operations were carried on under contract from December 8, 1892, to March 7, 1893, resulting in the improvement of the channel of Mermentau River for 38 miles from the lower end of Lake Arthur.

In 1894 an appropriation of $5,000 was made for continuing the improvement, and a project was submitted, but as the funds available were insufficient the amount was held for increase before undertaking further work.

A further appropriation of $5,000 having been made on June 3, 1896, a project was approved June 15, 1897, providing for construction of brush dams in Mud Lake (an enlargement of Mermentau River), and for dredging to secure immediate results. Under this project work was carried on from December 24, 1897, to April 14, 1898. An upper dam 2,500 feet long and 5 feet wide and a lower dam 3,000 feet long were constructed. The average depth of both bars dredged is 8 feet, width 50 feet.

The act of March 3, 1899, appropriated $6,115.25 for completing the improvement.

The sum of $16,606.58 was expended on these improvements up to June 30, 1899. From an examination made at that time it was found that the brush dams were in reasonably good condition, but that the channel through Mud Lake had shoaled in places because the material formerly dredged had not been deposited far enough away.

Dredging operations were carried on under contract from November 6 to December 22, 1899, and a channel through Mud Lake 6.5 feet deep and 3,877 feet long was completed. The dredged material was deposited on shore, and it is believed that the channel will now maintain itself.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1893	16,250	$324,900	....
1894	5,437	188,950	....
1895	15,955	300,163	10,518
1896	16,459	206,777	504
1897	12,210	278,286	....
1898	18,650	350,870	6,440
1899	22,236	429,500	3,586
Calendar year 1899	2,866	113,759	....

July 1, 1899, balance unexpended	$7,008.67
June 30, 1900, amount expended during fiscal year	5,399.84
July 1, 1900, balance unexpended	1,608.83
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V 11.)

12. Mouth and passes of Calcasieu River, Louisiana.—Prior to improvement there was a depth of 6½ feet of water over the outer bar at the entrance to Calcasieu Lake. Calcasieu Lake, which is 15 miles long, had a depth of 6 feet, the depth over the inner bars was 3½ feet, and from the upper bar to Lake Charles, La., there was not less than 8 feet of water.

The original project for improvement, adopted in 1872 and modified in 1881, provided for obtaining a channel of navigable width and depth across the inner bars. A channel 8 feet deep and 70 feet wide, for a distance of 7,500 feet, was dredged through the inner bars in 1874, 1882, and 1883, but in 1885 the channel had shoaled to 3½ feet. In accordance with project approved in 1886 the cut was redredged and a plank revetment on each side of the cut was commenced. The revetment was not finished, and the cut again filled.

An appropriation of $10,000, made in 1888, for the construction of a revetment, and another of $75,000, made in 1890, for constructing jetties, in accordance with projects submitted in 1886, were held for increase. These amounts were supplemented by an appropriation of $100,000, made in 1892.

The project approved August 13, 1892, under which the present work is being conducted, provides for dredging a channel 50 feet wide and 8 feet deep through the inner bars, revetting this channel to prevent the return of the dredged material, to build parallel jetties of brush and stone at the entrance to the outer pass, and to dredge out between these jetties to secure a depth of 12 feet, if necessary. The total estimated cost of these improvements is $600,000.

The revetment was completed August 16, 1893. Dredging at the foot of Calcasieu Lake was carried on in 1894–95 and in 1898. A channel 8 feet deep and 50 feet wide was secured, connecting deep water in Calcasieu Lake and Pass. The construction of the east jetty at the entrance to the pass was carried on in 1894, 1895, and 1896 and of the west jetty in 1897.

The sum of $398,660.30 was expended on these improvements up to June 30, 1899. At that time the east jetty had a length of 7,847 feet and the west jetty 2,200 feet. Both of these jetties had been damaged by severe storms. The maximum depth over the shoalest place through the outer jetties was 7.1 feet. The depth through the channel over the inner bars was 8 feet, and the revetment was in a dilapidated condition.

With the sum of $35,000, appropriated March 3, 1899, the foundation of the west jetty was extended 1,000 feet during the past year, work being carried on from January 19 to April 29, 1900. This work increased the length of the west jetty to 3,200 feet.

No work was done on repairing the jetties and the revetment, which, it is estimated, will cost $15,500. The outer channel had a depth of 7 feet, and the inner passes a depth of 6½ feet on June 30, 1900.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1893	207,545	$2,141,750	
1894	344,978	1,600,574	137,428
1895	254,394	788,274	
1896	202,775	691,542	
1897	141,029	664,870	
1898	190,017	745,071	48,988
1899	174,651	617,042	
Calendar year 1899	16,829	201,090	

July 1, 1899, balance unexpended	$37,839.70
June 30, 1900, amount expended during fiscal year	37,232.94
July 1, 1900, balance unexpended	606.76

Amount (estimated) required for completion of existing project	220,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	165,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix V 12.)

13. Johnsons Bayou, Louisiana.—This stream is tributary to Sabine Lake, Texas. A preliminary survey of it was made in connection with a survey of Sabine Lake in January, 1897. It had a minimum depth of 12 feet except over a bar at its mouth, where there was only 2½ feet of water. The estimated cost of removing the bar was $2,500, and this sum was appropriated by act of March 3, 1899.

The project approved April 10, 1899, provided for dredging the channel 6 feet deep and of such width as funds would permit (estimated 60 feet), from the 6-foot depth in Sabine Lake to the 6-foot depth in Johnsons Bayou.

Dredging was carried on at the mouth of the bayou from December 12 to December 26, 1899, the bar being removed and the required depth and estimated width obtained.

Nothing had been expended on this improvement up to June 30, 1899. The commerce from January 1 to December 31, 1899, amounted to 3,163 tons.

July 1, 1899, balance unexpended	$2,500.00
June 30, 1900, amount expended during fiscal year	2,261.35
July 1, 1900, balance unexpended	238.65

(See Appendix V 13.)

14. Removing the water hyacinth, Louisiana.—This is a new work. The Board of Engineers constituted in compliance with sundry civil act of June 4, 1897, submitted a report on November 30, 1898, relative to the extermination of the aquatic plant known as the water hyacinth from the navigable streams of Louisiana and Florida. The Board recommended the construction of two boats, one for use in Louisiana and the other in Florida, and also the use of log booms as an adjunct to the operations of the steamers. The report was transmitted to Congress and printed in House Doc. No. 91, Fifty-fifth Congress, third session, and also in Appendix P 11 of the Annual Report of the Chief of Engineers for 1899, page 1613 et seq.

In accordance with the recommendations of the Board, Congress by act of March 3, 1899, appropriated $36,000 for exterminating as far as practicable the water hyacinths from the navigable streams of Louisiana.

The project approved May 9, 1899, provides for the expenditure of $25,000 for the purchase or construction of a boat and machinery suitable for raising the plants and crushing them, $10,000 for conducting operations, and $1,000 for constructing log booms where necessary to prevent entrance of the hyacinths into navigable streams.

Under this project a steamboat of suitable size was purchased during the past year for $8,000, and the necessary machinery for raising and crushing the plants was constructed and installed at a cost of $4,750. A number of repairs were made to the hull of the steamer, and it is expected that the work of removing the hyacinths will be commenced early in July.

A boom with a gate arranged to allow the hyacinths to float out with the tides and to prevent their return was constructed at the mouth of Bayou Teche, Louisiana, one of the principal streams in Louisiana affected by the hyacinths. This work cost $968.92.

July 1, 1899, balance unexpended	$36,000.00
June 30, 1900, amount expended during fiscal year	12,645.75
July 1, 1900, balance unexpended	23,354.25
July 1, 1900, outstanding liabilities	5,795.73
July 1, 1900, balance available	17,558.52

(See Appendix V 14.)

15. Mouths of Sabine and Neches rivers, Texas.—These streams are tributary to Sabine Lake, Texas, and at their mouths are about 4 miles apart. Before any improvements were attempted, there was only 3½ feet of water over the bar at the mouth of Sabine River, and 3 feet over the bar at the mouth of Neches River. Dredging was carried on at the mouth of Sabine River in 1880 and 1895, a channel 60 feet wide and 7 feet deep being secured. Dredging was also carried on at the mouth of Neches River in 1880, 1889, and 1895, a channel 50 feet wide and 5 feet deep being provided for a distance of 8,000 feet, but before deep water in Sabine Lake was reached the funds available were exhausted.

A survey of the mouths of these streams was made in January, 1897, in connection with a survey of Sabine Lake. It was found that the channel at the mouth of Sabine River was in good condition, there being a navigable channel 7 feet deep and 50 feet wide. The channel at the mouth of Neches River had shoaled to about 4 feet, but the part that had been dredged last was in good condition.

The act of March 3, 1899, appropriated $10,000 for improving the mouths of these streams, the appropriation to include the expenses of a reexamination of the proposed channel through Sabine Lake by a Board of Engineer Officers.

The Board constituted in compliance with this act submitted on August 11, 1899, a report on the proposed channel through Sabine Lake, and the report is printed in House Doc. No. 100, Fifty-Sixth Congress, first session; it is also herewith as Appendix V 22.

The project approved July 14, 1899, provided for dredging a channel from deep water in the Neches River to deep water in Sabine Lake. Work under this project was carried on from January 2, to March 21, 1900. A distance of 7,829 feet was dredged, giving a channel 60 feet wide and 8 feet deep at mean low water, from the 7-foot contour of Neches River to the 6-foot contour of Sabine Lake, a total distance of 8,829 feet.

It was found that a shoaling had occurred in the outer end of the Sabine River channel, and on March 3, 1900, the remaining balance from this appropriation was authorized to be expended in removing this bar. Work was carried on from March 23 to April 3, 1900. A distance of 2,060 feet was dredged, completing a channel 60 feet wide and 7 feet deep at mean low water across the bar, from the 6-foot contour of Sabine River to the 6-foot contour of Sabine Lake.

The sum of $113.01 was expended from this appropriation up to June 30, 1899, for survey of the proposed channel through Sabine Lake.

The commerce of the Sabine and Neches rivers for the calendar year 1899 was 141,122 tons.

July 1, 1899, balance unexpended	$9,886.99
June 30, 1900, amount expended during fiscal year	9,812.28
July 1, 1900, balance unexpended	74.71
July 1, 1900, outstanding liabilities	74.71
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix V 15.)

16. *Sabine River, Texas.*—This stream is about 470 miles long, and for a greater part of its length forms the boundary between Texas and Louisiana. It flows into the Gulf of Mexico through Sabine Lake. Prior to improvement there was a depth of 3½ feet of water over the bar at the mouth of the river; from the mouth to Orange, Tex., there was ample depth; above Orange the stream was obstructed by logs and snags.

The original project, adopted in 1871 and modified in 1873, provided for deepening the main outlet of the river at a cost of $18,000.

The project of 1889 provided for the closure of two branches forming Old River, to throw all the water into the "narrows," and for the removal of obstructions. These projects were completed in December, 1890, and a navigable channel provided for vessels drawing 5 feet for a distance of 30 miles above Orange, Tex.

The project of 1892 provided for removing obstructions between Orange, Tex., and Sudduths Bluff, a distance of 50 miles, at an estimated cost of $10,000. This work was completed in 1895.

The sum of $48,799.21 was expended on these improvements up to June 30, 1899. At that time the dams built in 1890 were in good condition and fulfilling the requirements for which built. The river from the mouth to Morgans Bluff, a distance of 33 miles, was in fairly good condition, but obstructions had formed between Morgans Bluff and Sudduths Bluff, a distance of 31 miles, since 1895.

With $2,000 appropriated in 1896 and a like amount in 1899, the work of maintenance has been carried on since May 17, 1900. The river has been cleared of obstructions from Morgans Bluff to within about 23 miles of Sudduths Bluff, and it is expected that the latter point will be reached and the work completed by July 10, 1900. The river will then be in good condition for navigation from the mouth to Sudduths Bluff, with the exception of obstructions formed by floating loose logs.

Vessels drawing 5 feet can go 64 miles above the mouth of the river, and above Sudduths Bluff, for about 300 miles, vessels of light draft can run during high water.

In connection with this work see report (above) for improving the mouths of the Sabine and Neches rivers, Texas.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1893	146,363	$1,591,280	
1894	245,657	1,518,630	99,294
1895	182,738	736,044	
1896	271,257	979,380	98,519
1897	245,364	1,181,154	
1898	275,506	1,394,557	30,142
1899	270,642	1,106,993	
Calendar year 1899	407,372	1,369,681	136,730

July 1, 1899, balance unexpended		$3,900.79
June 30, 1900, amount expended during fiscal year		264.21
July 1, 1900, balance unexpended		3,636.58
July 1, 1900, outstanding liabilities	$2,816.50	
July 1, 1900, amount covered by uncompleted contracts	695.00	
		3,511.50
July 1, 1900, balance available		125.08

(See Appendix V 16.)

17. Harbor at Sabine Pass, Texas.—Sabine Pass, about 7 miles long, is the outlet of Sabine Lake into the Gulf of Mexico. Prior to improvement it had a least depth of 25 feet, except over a bar 200 feet long opposite the town of Sabine Pass, over which there was a depth of 18 feet, and a bar 200 feet long opposite Fort Point, where there was a depth of 17 feet. Beyond the shore line, where the pass enters the Gulf of Mexico, there was a bar 3½ miles wide between the interior and exterior 18-foot bottom curves, over which there was only a depth of 6 feet at mean low tides. Channels 12 and 15 feet deep were dredged through the outer bar in 1878 and 1880, but the improvement was not permanent and the cuts soon filled.

The project of 1882 proposed to construct parallel jetties of brush and stone, extending from shore across the bar out to deep water in the Gulf, the jetties to be 1,800 feet apart and about 4 miles long; dredging between jetties to be carried on, if necessary, to obtain deep water through the pass into the harbor. The estimated cost of the improvements was $3,177,606.50.

By the river and harbor act of 1896 contracts were authorized to be entered into for the completion of the project of improvement, the cost being limited to $1,050,000.

Act of June 4, 1897, appropriated $100,000 for the purchase of a dredge boat for Sabine Pass, and $30,000 for operating same during the fiscal year 1898, and a project to that effect was approved June 29, 1897. There having been delays in the construction of the dredge boat the project was modified by act of March 17, 1898, making available for immediate use $15,000 of the $30,000 appropriated for dredging.

Act of March 3, 1899, appropriated $150,000 for straightening, widening, and otherwise improving the main ship channel by removal of oyster reefs and flats, and other material, between a point 1,000 feet north of the United States life-saving station and a point opposite the United States light-house. A project covering the proposed work was approved by the Secretary of War on March 27, 1899.

The work of jetty building began in 1883, and, with successive appropriations, has been carried on since then.

The project approved December 8, 1896, for the expenditure of the $1,050,000 authorized by act of 1896, provides for the construction of 5,300 linear feet, more or less, of the east jetty, and 6,600 feet, more or less, of the west jetty, at a cost of $985,000, and that $65,000 be expended in the enlargement and maintenance of the dredged channel.

A contract for this work was approved June 22, 1897, and work was commenced on August 10, 1897. On June 30, 1897, the east jetty had a length of 19,500 feet, and the west jetty 14,875 feet; on June 30, 1899, the east jetty had been extended to a length of 24,800 feet, and the west jetty to 18,575 feet. About 3,000 feet of the previous work was capped in 1897. Dredging in the channel, under this contract, was carried on in 1897 and 1899, which increased the depth to 25 feet and the width to 100 feet.

Under the act of March 17, 1898, dredging in the channel was carried on in July, 1898, at a cost of $13,702.97. The remainder of the $30,000 appropriated June 4, 1897, not being available after June 30, 1898, reverted to the Treasury. An allotment of $8,000 from the appropriation provided by the emergency river and harbor act of June 6, 1900, was made July 19, 1900, for dredging.

The sum of $2,661,256.24 was expended on these improvements up to June 30, 1899.

During the past fiscal year the east jetty was extended 300 feet, making the total length 25,100 feet, of which 21,540 feet is capped, 960 feet is riprap work, and 2,600 feet is foundation work only. The west jetty was extended 3,425 feet, making the total length 22,000 feet, of which 15,250 feet is capped, 1,800 feet is riprap work, and 4,950 feet is foundation work only. It is expected that jetty construction under the present contract will be completed in July, 1900.

A contract for dredging in Sabine Pass channel, within the area prescribed by act of March 3, 1899, was entered into July 27, 1899, and was approved September 22, 1899, but no work was done by the contractors except the removal of 1,414 cubic yards of material in April, 1900. The contractors report that the failure to comply with their contract is due to various causes, among which is a deficiency in plant for putting the material ashore, and that a new hydraulic pump has been ordered.

A contract for the construction of a hydraulic dredging steamer with two 10-inch pumps was entered into January 19, 1900, and the work of construction is now in progress. The dredge boat should be completed in November, 1900.

Sabine Pass now has a navigable depth of 21.3 feet, but the bottom is composed of soft mud, and a vessel recently went out drawing 24.3 feet.

There has been an unusual and unexpected amount of settlement of the jetties, and additional work is desirable beyond that contemplated by the original project to secure the full benefits of the improvement. It is estimated by the officer in local charge of this improvement that a further expenditure of $550,000 for maintenance, restoration, and extension is necessary.

Comparative statement of receipts and shipments for eight years.

Year ending May 31—	Tons.	Value.	Increase over previous year.
			Tons.
1893	15,050	$180,950	....
1894	40,966	280,189	25,916
1895	47,691	252,823	6,725
1896	48,886	199,042	1,195
1897	87,632	475,288	38,746
1898	238,400	2,363,542	150,768
1899	326,982	5,451,615	88,582
Calendar year 1899	326,494	3,058,162	....

July 1, 1899, balance unexpended		$731,196.73
Amount appropriated by sundry civil act approved June 6, 1900		36,000.00
		767,196.73
June 30, 1900, amount expended during fiscal year		370,780.75
July 1, 1900, balance unexpended		396,415.98
July 1, 1900, outstanding liabilities	$89,945.76	
July 1, 1900, amount covered by uncompleted contracts	265,403.37	
		355,349.13
July 1, 1900, balance available		41,066.85
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		356,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix V 17.)

18. Homochitto River, Mississippi.—This is a new work. About 8 miles above Fort Adams, Miss., the Homochitto enters the Mississippi River. For the first 3 miles it is called the "Narrows," and for a distance of 12 miles farther it takes the name of "Old River." A preliminary examination in 1896 showed that the Narrows had a depth of 5 feet at low water and a width of 150 feet, except for about 1 mile, where it is very narrow and shoal. This part of the river was obstructed by snags and trees. Old River is about 1,000 feet wide, 2 feet deep over the shoalest places at low water, and is clear of obstructions. Above Old River the Homochitto had a navigable depth of 8 feet and a width of 150 feet for a distance of 45 miles, but was thickly obstructed by snags, logs, and overhanging trees.

Act of March 3, 1899, appropriated $16,000 for removing obstructions between the mouth of the river and the Yazoo and Mississippi Valley Railroad, a distance of about 60 miles, and a project was approved April 18, 1899, covering this work.

Work under this project has been carried on since November 27, 1899. Obstructions were removed from the Narrows, and the action of natural scour has removed most of the bars. Obstructions were also removed from 9 miles of channel above Old River. The work was considerably hindered by high water during the period from February to May, 1900. It is expected that the work under contract will be completed by July 20, 1900.

On June 30, 1900, the channel, for a distance of 18 miles from the mouth, was navigable during high water by vessels drawing 6 feet, and during low water by vessels drawing 2 feet.

The commerce during the past year was 3,815 tons.

July 1, 1899, balance unexpended		$16,000.00
June 30, 1900, amount expended during fiscal year		9,222.86
July 1, 1900, balance unexpended		6,777.14
July 1, 1900, outstanding liabilities	$2,780.87	
July 1, 1900, amount covered by uncompleted contracts	996.80	
		3,777.67
July 1, 1900, balance available		2,999.47
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V 18.)

19. Removing sunken vessels or craft obstructing or endangering navigation.—The removal of the wreck of the bark *Alice* from the channel at Sabine Pass was authorized by the Secretary of War on April 10, 1900. This work was commenced on May 23 and completed June 30, 1900, at a cost of $1,800.

(See Appendix V 19.)

EXAMINATION AND SURVEY OF ATCHAFALAYA BAY, LOUISIANA, FROM THE MOUTH OF ATCHAFALAYA RIVER TO DEEP WATER IN THE GULF, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of *Atchafalaya Bay, Louisiana from the mouth of Atchafalaya River to deep water in the Gulf* were made by the local engineers, and reports thereon dated April 11, 1899, by Maj. James B. Quinn, Corps of Engineers, and January 19, 1900, by Maj. H. M. Adams, Corps of Engineers, respectively, were submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers. The plan for improvement presented by Major Adams in report on survey is estimated to cost $1,939,399.08, but in his opinion, concurred in by the division engineer, the locality is not worthy of improvement to the extent proposed in the act. The reports were transmitted to Congress and printed in House Doc. No. 410, Fifty-sixth Congress, first session. (See also Appendix V 20.)

PROJECT OF BOARD OF ENGINEERS FOR IMPROVEMENT OF THE SOUTHWEST PASS, MISSISSIPPI RIVER, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

A Board of Engineers constituted in accordance with requirements of the river and harbor act of March 3, 1899, to prepare and report a project for securing a navigable channel of suitable width and of 35 feet depth at mean low water throughout the *Southwest Pass of the Mississippi River*, submitted report dated January 11, 1900, with project for improvement at an estimated cost of $6,000,000, and $150,000 additional per annum for maintenance. The report was transmitted to Congress and printed in House Doc. No. 329, Fifty-sixth Congress, first session. (See also Appendix V 21.)

REPORT OF BOARD OF ENGINEERS ON REEXAMINATION OF PROPOSED CHANNEL THROUGH SABINE LAKE, TEXAS AND LOUISIANA, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

A Board of Engineers constituted in accordance with requirements of the river and harbor act of March 3, 1899, to reexamine and report upon the proposed *channel through Sabine Lake, Texas and Louisiana*, submitted report with plan for improvement via Route C, at an estimated cost of $300,000. In the opinion of the Board any channel through the lake will require dredging for maintenance and the report contemplates the purchase of a suitable dredge at a cost of $100,000, and an annual appropriation of $50,000 for its operation. The report was transmitted to Congress and printed in House Doc. No. 100, Fifty-sixth Congress, first session. (See also Appendix V 22.)

EXAMINATION OF SABINE PASS, TEXAS, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Sabine Pass, Texas, with a view to widening and straightening the main ship channel and increasing the depth, if necessary, from a point 1,000 feet north of the United States life-saving station to Sabine Lake*, required by the emergency river and harbor act of June 6, 1900, and report thereon will be transmitted to Congress at its next session.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

This district was in the charge of Capt. C. S. Riché, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Galveston Harbor, Texas.*—Galveston Harbor embraces an anchorage area of over 1,960 acres, of which 1,500 acres has a depth of more than 20 feet, and 460 acres has a depth of more than 30 feet. It affords vessels excellent shelter from storms. Waterways connect it with Houston and with Brazos River.

The entrance to this harbor was originally obstructed by two bars, known as the inner and outer. The natural depth on the inner bar was about 9½ feet, and on the outer bar about 12 feet. These shallow depths prevented all but the lightest-draft vessels from using the harbor, and necessitated the lighterage of cargoes to the larger vessels anchored in the deep water beyond the outer bar.

Prior to 1874 the projects for improving this harbor related to dredging operations on a small scale, and were only expected to afford temporary relief to navigation.

The original project for the permanent improvement of this harbor was adopted June 23, 1874, and contemplated the construction of jetties, which were expected to deepen the channel on the bar to 18 feet, the cost being estimated at $1,759,400 (see Annual Report of the Chief of Engineers for 1874, p. 722 et seq.). The method used in jetty construction having proved unsatisfactory, the subject of the improvement was referred to a Board of Engineers, which, on June 7, 1880, formulated a modified project, which also contemplated the building of jetties at a cost of $1,825,813. It was expected that, upon their completion, a least depth of 25 feet would be obtained on the outer bar (see Annual Report of the Chief of Engineers for 1880, p. 1221 et seq.). On February 20, 1886, a Board of Engineers again considered the subject of this improvement and adopted a modified project which had in view a possible depth of 30 feet, by constructing the jetties to a height of 5 feet above mean low tide and extending them to the 30-foot contour in the Gulf, and to supplement the action of the tidal scour by dredging. The estimated cost of this revised project was $7,000,000, in addition to sums previously spent, which amounted to $1,478,000, making the aggregate cost of this improvement $8,478,000 (see Annual Report of the Chief of Engineers for 1886, p. 1294 et seq.).

The total amount expended under the foregoing plans to June 30, 1899, was $8,328,265.74, with an additional sum of $100,000 subscribed by the city of Galveston in 1883.

This expenditure resulted in a depth of 26 feet at mean low tide on the outer bar, an increase of 14 feet since work began, and a depth of 26 feet at mean low tide on the inner bar, an increase of 16 feet during the same period. This increased depth of water enabled vessels to load to their full capacity at the Galveston wharves, thereby making the lighterage of cargoes no longer necessary.

The expenditure during the fiscal year ending June 30, 1900, has been for operating the U. S. dredge *Gen. C. B. Comstock*, in maintaining, straightening, and widening the channel between the jetties, expenses of resurvey and chart of Galveston Bay, and contingent expenses of the work.

The depth of water on the outer and inner bars remains the same as at the end of the last fiscal year.

At the end of the fiscal year the completed south jetty extended 35,603 feet. On the same date the completed north jetty extended a distance of 25,907 feet.

Commerce has been greatly benefited by the improvement of this harbor, as shown by the increased size and tonnage of the vessels using the port. The amount of freight handled during the fiscal year was 1,896,513 tons.

The total amount of ocean commerce transported to and from Galveston during the fiscal year was: Cotton and cotton products, 698,365 tons; grain, 646,954 tons; coal, 142,108 tons; wool, 16,496 tons; ore, 7,769 tons; sugar, 1,064 tons; general merchandise, 383,757 tons.

It will be necessary, for a time at least, to maintain a dredge at Galveston to remove any shoaling that may take place in the improved channel, and it is estimated that $50,000 will be required during the next fiscal year for the maintenance and operation of the dredge belonging to this improvement. This is the amount that will be needed each and every year for this purpose. A reserve of at least $50,000 should also always be on hand for the immediate repair of any breaches in the jetties that may be caused by excessive storms.

July 1, 1899, balance unexpended	$200,034.26
June 30, 1900, amount expended during fiscal year	56,813.37
July 1, 1900, balance unexpended	143,220.89
July 1, 1900, outstanding liabilities	2,051.89
July 1, 1900, balance available	141,169.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix W 1.)

2. *Deepening the channel from Galveston Harbor to Texas City, Tex.*—This channel is designed to afford a channel 100 feet wide at bottom and 25 feet deep north of Pelican Island from Galveston Harbor to Texas City, Tex. The natural depth on the line of the proposed channel is from 4 to 8 feet. During 1895 and 1896 a channel 16 feet deep was dredged by the Texas City Terminal Company. No work having been done since then, it had at the close of the fiscal year shoaled nearly to its natural depth.

Bids received during fiscal year ending June 30, 1899, were rejected and new bids were advertised for during the fiscal year, and contract for dredging the proposed channel has been entered into, work to commence, as extended, June 30, 1900. No work was done during the fiscal year except to mark out the proposed channel and dumping grounds, erect survey beacons and tide gauge house. At close of fiscal year contractors were on the ground making preparations for commencing work.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained.

July 1, 1899, balance unexpended	$250,000.00
July 1, 1900, balance unexpended	250,000.00
July 1, 1900, amount covered by uncompleted contracts	250,000.00

(See Appendix W 3.)

3. *Improving Galveston Ship Channel and Buffalo Bayou, Texas.*—These improvements have heretofore been reported on individually under headings of "Ship channel in Galveston Bay, Texas," and "Buffalo Bayou, Texas." The river and harbor act of March 3, 1899, combines the works under one item.

The "ship channel in Galveston Bay" and "Buffalo Bayou" are two links in the waterway connecting Houston with deep water in Galveston Bay, the other links being the San Jacinto River and the Morgan Canal.

In their natural state these two waterways had a depth of from 4 to 8½ feet. The project adopted for the improvement provided for a channel 100 feet wide and 12 feet deep. Dredging was carried on for a number of years, furnishing a channel sufficient for the character of vessels heretofore navigating these channels.

No dredging work was carried out during the past year.

In 1892 the Government purchased the Morgan Cut and Canal, 5.43 miles long, from the Buffalo Bayou Ship Channel Company for the sum of $92,316.85.

There has been expended on these channels to June 30, 1899, including cost of canal, $1,102,782.65, and there remains available for expenditure from appropriations made previous to 1899 the sum of $55,560.56.

An act of Congress approved February 1, 1897, provided for an "examination and survey of a water route from the mouth of the jetties at the city of Galveston, Tex., through the ship channel and up Buffalo Bayou to Houston, Tex." The examination was made by a Board of Engineers, and their report is printed in House Doc. No. 99, Fifty-fifth Congress, second session, and in the Annual Report of the Chief of Engineers for 1898, page 1515 et seq.

The act of Congress approved February 20, 1900 (Public No. 23), entitled "An act to amend an act making appropriation for the construction, repair, and preservation of certain public works on rivers and harbors and for other purposes, approved March third, eighteen hundred and ninety-nine," repealed the items of appropriation in the river and harbor act of March 3, 1899, relating to the improvement of Galveston ship channel and Buffalo Bayou, Texas, and the following amendment was substituted in lieu thereof, viz:

> Improving Galveston Ship Channel and Buffalo Bayou, Texas: For improvement of the Galveston Ship Channel and Buffalo Bayou, by dredging or otherwise in accordance with the project submitted by a board of engineers in the report of a survey dated November third, eighteen hundred and ninety-seven, and submitted by the Chief of Engineers in his report for eighteen hundred and ninety-eight, in volume one, pages two hundred and eighty-eight and two hundred and eighty-nine, three hundred thousand dollars: *Provided*, That all sums heretofore appropriated and available for work on Galveston Ship Channel and Buffalo Bayou are hereby made available for said project: *Provided further*, That all of said sums of money not necessary for administration, surveys, and maintenance be used in improving division one of said survey.

The approved project for the expenditure of the available funds consists in dredging a channel about 80 feet wide and 17½ feet deep from deep water in Galveston Harbor through Galveston Bay and Morgan Cut (Division 1) and constructing pile and brush dike from Morgan Cut to Redfish Bar. The sum of $25,000 is reserved for expenditure for expenses of administiation, surveys, and maintenance above Division 1 (through San Jacinto Bay to Houston, Tex.).

During the fiscal year the necessary surveys have been under way and bids were advertised for and received for doing the proposed work. Up to the close of the fiscal year contract had not been awarded.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained. Inquiries by letter were made, but no replies had been received up to June 30, 1900.

SHIP CHANNEL IN GALVESTON BAY.

July 1, 1899, balance unexpended	$48,688.69
June 30, 1900, amount expended during fiscal year	11,727.99
July 1, 1900, balance unexpended	36,960.70
July 1, 1900, outstanding liabilities	750.18
July 1, 1900, balance available	36,210.52

BUFFALO BAYOU.

July 1, 1899, balance unexpended	$18,612.36
June 30, 1900, amount expended during fiscal year	12.50
July 1, 1900, balance unexpended	18,599.86

GALVESTON SHIP CHANNEL AND BUFFALO BAYOU.

July 1, 1899, balance unexpended	$300,000.00
July 1, 1900, balance unexpended	300,000.00

Amount (estimated) required for completion of existing project	3,700,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix W 4.)

4. Operating and care of Morgan Canal, Texas.—The expenses of caring for this canal during the fiscal year ending June 30, 1900, amounted to $360, which was paid from the permanent-indefinite appropriation provided by section 4, act of July 5, 1884. A statement contained in the report of the local engineer officer shows the items of expenditure.

(See Appendix W 5.)

5. Trinity River, Texas.—The improvement of this stream has been limited to that portion lying between the mouth and Liberty at the head of tide water, a distance of 39 miles. The river empties into Galveston Bay through several mouths or passes, opposite each of which a bar existed on which the depth of water did not exceed 3¼ feet at mean low tide.

The project adopted for this improvement on June 18, 1878, consisted in the removal of snags from the river below Liberty and in dredging a channel 80 feet wide by 6 feet deep across the bar at the mouth of the pass then in use by vessels. The estimated cost of the work was $22,581.40 (see Annual Report of the Chief of Engineers for 1873, p. 685 et seq.). On May 4, 1889, an amended project was adopted. It contemplated the erection of two parallel jetties at the mouth known as the Middle Pass, placed about 275 feet apart and extending about 7,750 feet into Galveston Bay; also in closing the other two principal passes by submerged dams, the object being to create and maintain a channel 6 feet deep at mean low tide at the mouth of the river. The revised cost of the improvement was placed at $89,500 (see Annual Report of the Chief of Engineers for 1889, p. 1557 et seq.).

The amount expended on this improvement to the close of the fiscal year ending June 30, 1899, was $69,444.76.

At that date the west jetty had been completed, its length being 7,359 feet, and a channel 100 feet wide by 5 feet deep had been secured at the mouth of the river.

Owing to rises in the river twice during the fiscal year, log jams have had to be removed from the Middle Pass of the river and once from Browns Pass to enable boats to go up the river. The cost of removing these jams was $941.57.

Work done during the fiscal year was limited, for the reason that there was sufficient depth of water on the bar at the mouth to accommodate all vessels heretofore navigating the river.

By act of Congress approved March 3, 1899, an appropriation was made for the construction of a dredge boat and snagging outfit in connection with the improvement of Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams, which, by the law, will be available for use on the Trinity River. (See report No. 8 herewith, p. 391.)

With the $7,000 appropriated by river and harbor act approved March 3, 1899, a survey was made from Dallas, Tex., to the mouth, and a log jam at Browns Pass removed. The report upon the survey is printed in House Doc. No. 409, Fifty-sixth Congress, first session; it is also herewith as Appendix W 16.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained. Inquiries by letter were made, but no replies had been received up to June 30, 1900.

July 1, 1899, balance unexpended	$14,555.24
June 30, 1900, amount expended during fiscal year	7,804.61
July 1, 1900, balance unexpended	6,750.63

(See Appendix W 6.)

6. *Channel in West Galveston Bay, Texas.*—West Galveston Bay is a body of water covering about 39 square miles, and lies between Galveston Island and the mainland. It extends from Galveston Bay to the west end of Oyster Bay, and is connected with the Gulf of Mexico by San Luis Pass, at the western extremity of Galveston Island, and with the Brazos River by the Galveston and Brazos Canal. The natural depth of the bay was from 2½ to 3 feet.

The project for improving the bay was adopted on June 13, 1892, and consisted in widening, deepening, and straightening the channel so as to give a width of 200 feet and a least depth of 3½ feet from Galveston Bay to San Luis Pass and a channel 100 feet wide and 3 feet deep along Christmas Point, in Oyster Bay, both channels to be properly defined by beacons. The estimated cost of the improvement was $28,998.80 (see Annual Report of the Chief of Engineers for 1892, p. 1556 et seq.). On July 8, 1896, authority was given to modify the project so as to afford a depth of 5 feet instead of 3½ feet, provided the cost of the work was not increased.

By act of Congress approved March 3, 1899, an appropriation was made for construction of a dredge boat and snagging outfit in connection with improvement of Brazos River, between Velasco and Richmond, Double Bayou, and the mouths of adjacent streams, which, by the terms of the law, will be available for use in West Galveston Bay. (See report No. 8, herewith, p. 391.)

The amount expended to June 30, 1899, was $19,775.97.

This expenditure resulted in an unobstructed channel 100 feet wide and from 3 to 3½ feet deep from Galveston Bay to the Galveston and Brazos Canal. Beacons were also erected to define the channel.

No work was done during the fiscal year, for the reason that a greater depth of water existed in the bay than was found in the Galveston and Brazos Canal, which is owned by a private corporation having the right to charge tolls, and through which all vessels plying between Galveston and the Brazos River usually pass.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained.

July 1, 1899, balance unexpended	$5,224.03
July 1, 1900, balance unexpended	5,224.03

(See Appendix W 8.)

7. *Mouth of Brazos River, Texas.*—The improvement of the mouth of this stream has heretofore been undertaken by the Brazos River Channel and Dock Company, they having partially constructed a system of parallel jetties.

The river and harbor act approved March 3, 1899, contains the following item:

> Mouth of Brazos River, Texas: For dredging, and such other work as may be deemed most effective in the judgment of the Secretary of War in improving and developing the harbor, eighty-five thousand dollars: *Provided,* That no part of said sum shall be expended until the Brazos River Channel and Dock Company shall file with the Secretary of War a transfer to the United States of the jetties, and auxiliary works; also a release of all rights and privileges conferred upon said company by its charter or by the Act of Congress approved August ninth, eighteen hundred and eighty-eight, to charge or collect tolls for the use and navigation of said river; and the Secretary of War is directed to have an examination made of the mouth of the Brazos and the jetties, and report to Congress the estimated cost of extending the jetties one-half mile, and the estimated depth and width of the channel to be obtained by such extension, and the estimated cost of obtaining twenty feet of water and a channel one hundred and fifty feet wide.

Under date of April 25, 1899, the Brazos River Channel and Dock Company filed with the Secretary of War a transfer to the United States of these jetties and auxiliary works, also a release of all rights and privileges conferred upon the said company by its charter or by the act of Congress approved August 9, 1888, to charge or collect tolls for the use and navigation of the river.

The proposed work at this locality consists in putting the present jetties at the mouth of the river in a fair condition to resist the effects of storms and to protect a dredge while working between them, also to make a beginning in the construction of spur dikes to narrow the channel between the jetties, and to dredge a channel as far up as the lighthouse to a depth of 18 feet at mean low tide and 150 feet wide.

The amount expended on this improvement up to June 30, 1899, was $142,098.43.

A contract was entered into on October 19, 1899, for doing the necessary jetty work at the mouth of the river.

At the close of the fiscal year ending June 30, 1900, the progress of the work was as follows:

Northeast jetty.—Completed between Stations 30 to 35+50, 36 to 39, 41 to 43, 45 to 47+08 the end; blocks placed but not complete; more blocks yet required between Stations 29 to 30, 39 to 41, and 43 to 45. Wing dams at Stations 31 and 39 completed. Outer wing dam at Station 46 practically completed.

Southwest jetty.—Completed between Stations 33 and 44; between Stations 44 and 47 block is all placed, but more riprap is required to fill voids between blocks. Between Stations 30 and 33 the jetty is practically completed, blocks required.

The available balance and any further appropriation will be applied to repairing the jetties, building spur dikes, and dredging.

The report on examination of the mouth of the Brazos River and the jetties, as provided for by act approved March 3, 1899, was submitted and is printed in House Doc. No. 652, Fifty-sixth Congress, first session; it is also herewith as Appendix W 24.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained. Inquiries by letter were made, but no replies had been received up to June 30, 1900.

July 1, 1899, balance unexpended		$85,000.00
Reallotment of balance of appropriation of act of August 5, 1886		16,651.57
		101,651.57
June 30, 1900, amount expended during fiscal year		33,866.56
July 1, 1900, balance unexpended		67,785.01
July 1, 1900, outstanding liabilities	$15,010.77	
July 1, 1900, amount covered by uncompleted contracts	25,091.62	
		40,102.39
July 1, 1900, balance available		27,682.62

Amount (estimated) required for completion of existing project	150,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	120,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W 9.)

8. *Improvement of the Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams.*—The river and harbor act approved March 3, 1899, provides as follows:

> For the improvement of the Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams, sixty-five thousand dollars, out of which said sum a suitable dredge and snagging outfit may be provided to carry on said work and to be used on other approved projects on the Texas coast, including streams emptying into the Gulf of Mexico and bays connected therewith.

Heretofore the projects embraced in this improvement have been independent (see improving Brazos River, Texas, between Velasco and Richmond, Annual Report of the Chief of Engineers for 1895, p. 1838 et seq.; improving channel of West Galveston Bay, Annual Report of the Chief of Engineers for 1892, p. 1556 et seq., and improving Double Bayou, Annual Report of the Chief of Engineers for 1898, p. 287 et seq.).

The object of the improvement, in part, is to obtain and maintain a navigable channel depth of from 4 to 6 feet across the bars at the mouths of most of the streams and bayous along the Texas coast by dredging and snagging, the plant to be owned and operated by the United States.

The improvement is intended to develop a light-draft inland navigation tributary to Galveston and other Texas harbors which will afford cheap transportation by light-draft steamers and barges to the fertile coast country of Texas.

Preliminary arrangements have been made for obtaining a suitable combined dredge and snag boat.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained.

July 1, 1899, balance unexpended	$65,000.00
July 1, 1900, balance unexpended	65,000.00

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W 10.)

9. Brazos River, Texas.—This improvement is at present limited to that portion of the river lying between Richmond and Velasco, a distance of about 89 miles; its low-water level is affected by the Gulf tide as far up as Bolivar Landing, 40 miles above Velasco. The course of the river is tortuous, and the channel was obstructed by shoals and snags.

The project for improvement was adopted June 3, 1896, and consisted in the removal of snags and overhanging trees. It was estimated that $10,000 would put this portion of the river in good navigable condition at ordinary stages, and that an annual expenditure of $2,500 would keep it in this condition (see Annual Report of the Chief of Engineers for 1895, p. 1838 et seq.).

No work has been done under this project, owing to the unfavorable stages of water in the river.

By act of Congress approved March 3, 1899, an appropriation was made for the construction of a dredge boat and snagging outfit in connection with improvement of Brazos River, West Galveston Bay Channel, Double Bayou, and the mouths of the adjacent streams. (See report No. 8, herewith, page 391.) This plant will be available for use on this river.

Amount expended on this improvement to June 30, 1899, $20.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained.

July 1, 1899, balance unexpended	$4,980.00
June 30, 1900, amount expended during fiscal year	1.57
July 1, 1900, balance unexpended	4,978.43

(See Appendix W 11.)

10. Aransas Pass, Texas.—Aransas Pass is on the south coast of Texas, 175 miles southwest of Galveston and 125 miles north of the Rio Grande, and is the outlet of Aransas Bay to the Gulf of Mexico. The area of the bay is about 80 square miles. It is connected with Corpus Christi Bay on one side and with the shallow bays of Mosquite, St. Charles, and Copano on the other.

For projects and work done by the United States Government and private corporations at Aransas Pass, see Annual Report of the Chief of Engineers for 1898, page 1527 et seq.

The river and harbor act of March 3, 1899, contains the following item:

> Improving Aransas Pass, Texas: For dredging and other improvement of Aransas Pass Harbor, sixty thousand dollars: *Provided,* That the Secretary of War is hereby authorized to contract for the removal of that portion of the old Government jetty in said harbor from the end nearest the curved jetty constructed by the Aransas Pass Harbor Company to the wreck *Mary,* in such manner as to in no wise interfere with the curved jetty now located in said harbor: *And provided further,* That said contract shall not be let by the Secretary of War, nor said work done, until the said Aransas Pass Harbor Company shall have properly released and surrendered all rights and privileges heretofore granted to it in said harbor by Congress, also the jetty constructed in said harbor.

The Aransas Pass Harbor Company, under date of March 27, 1899, having released and surrendered all rights and privileges heretofore granted to it in Aransas Harbor by Congress, also the jetties constructed in said harbor, a project was submitted for work at this locality under the appropriation made by the river and harbor act approved March 3, 1899, work to be confined to constructing two parallel jetties; also in removing a portion of the old Government jetty and in dredging, with a view of obtaining a channel 20 feet deep with a bottom width of 300 feet.

Between 1879 and 1890 $540,477.65 was expended upon the improvement of Aransas Pass and Bay, exclusive of $9,938.93 subscribed by citizens of Rockport and Corpus Christi. The amount expended upon present project to June 30, 1899, $135.70, was for office expenses, etc.

A contract was entered into January 8, 1900, for dredging, but work was not commenced during the fiscal year. The amount expended during the fiscal year was for office expenses and for survey of the locality, with a view to the preparation of a project.

A proposal for completing a portion of the north jetty was opened July 30, 1900, but the bid was rejected, as the prices were excessive.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained. Inquiries by letter were made, but no replies had been received up to June 30, 1900.

July 1, 1899, balance unexpended		[1]$100,636.65
June 30, 1900, amount expended during fiscal year		3,515.66
July 1, 1900, balance unexpended		97,120.99
July 1, 1900, outstanding liabilities	$35.00	
July 1, 1900, amount covered by uncompleted contracts	53,750.00	
		53,785.00
July 1, 1900, balance available		43,335.99
Amount (estimated) required for completion of existing project		1,680,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		350,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W 12.)

11. *Improving harbor at Brazos Santiago, Tex.*—No work has been done on this improvement since 1884. This work was dropped from the list of improvements in the Galveston district in December, 1895, and the available balance returned to the Treasury.

Owing to the shoaling of the bar, practically cutting off all water communication, authority was secured to use the balance, $57,476, remaining in the Treasury, it being the intention to dredge a channel over the bar to give temporary relief to the locality. Project has been approved with a view to hiring a dredging plant. Bids for hiring a plant were received during fiscal year, but were rejected on account of prices being excessive. New bids will be called for.

The amount expended during the fiscal year was for office expenses, etc.

No commercial statistics for the fiscal year ending June 30, 1900, could be obtained. Inquiries by letter were made, but no replies had been received up to June 30, 1900.

July 1, 1899, balance unexpended	$57,476.00
June 30, 1900, amount expended during fiscal year	331.15
July 1, 1900, balance unexpended	57,144.85

(See Appendix W 13.)

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[1] Includes a balance of $40,772.35 from appropriation of August 11, 1888, for improving Aransas Pass and Bay up to Rockport and Corpus Christi.

12. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of the steamship *City of Waco* has been a menace to navigation, being in the track of vessels entering and leaving Galveston Harbor.

During the fiscal year an examination of the wreck was made and an allotment made from the permanent-indefinite appropriation for removing sunken vessels or craft obstructing or endangering navigation, act of March 3, 1899, to pay for the removal of the wreck; bids were received and contract awarded. Contractor completed the work February 14, 1900. The total cost of examining wreck, inspection, superintendence, office expenses, and removing the wreck was $3,078.07.

(See Appendix W 14.)

SURVEY OF GALVESTON BAY AND HARBOR, TEXAS, REQUIRED BY THE SUNDRY CIVIL ACT APPROVED JUNE 4, 1897.

The local officer was charged with the duty of making this survey, report upon the results of which will be duly submitted when received.

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. C. S. Riché, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Henry M. Roberts, Corps of Engineers:

1. Preliminary examination and survey of Turtle Bayou, Texas.—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan for improvement, at an estimated cost of $10,000. In the opinion of Captain Riché, concurred in by the division engineer, the locality is worthy of improvement as a component part of an inland light-draft navigation system. The cost of this work is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 440, Fifty-sixth Congress, first session. (See also Appendix W 15.)

2. Survey of Trinity River, Texas, from its mouth to Dallas.—Captain Riché submitted report dated December 23, 1899. Three plans for improvement are presented, the estimated cost being—for a 4-foot navigation, $4,000,000; for a 5-foot navigation, $4,200,000; and for a 6-foot navigation, $4,550,000. The local officer considers the improvement of the river for a 4-foot navigation from Dallas to the mouth not only advisable but urgently necessary; and the division engineer states that in his opinion the river is worthy of improvement by the General Government to the extent of providing a 6-foot navigation from its mouth to Dallas. The report was transmitted to Congress and printed in House Doc. No. 409, Fifty-sixth Congress, first session. (See also Appendix W 16.)

3. Preliminary examination and survey of East Bay Bayou, Texas.—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan for improvement, at an estimated cost of $10,000. In the opinion of the local officer the locality is not worthy of improvement by the General Government on its own account, but as a component part of an inland canal to connect Galveston Bay with Sabine Lake it would be worthy of improvement, and this opinion is concurred in by the division engineer. The cost of this work is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 451, Fifty-sixth Congress, first session. (See also Appendix W 17.)

4. *Preliminary examination and survey of Clear Creek, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan for improvement, at an estimated cost of $10,000. In the opinion of the local officer the locality is worthy of improvement by the General Government as a component part of an inland light-draft navigation system, and his views are concurred in by the division engineer. The cost of this improvement is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 449, Fifty-sixth Congress, first session. (See also Appendix W 18.)

5. *Preliminary examination and survey of Dickinson Bayou, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan and estimate for improvement at an estimated cost of $7,500. In the opinion of the local officer, concurred in by the division engineer, the locality is worthy of improvement by the General Government as a component part of an inland light-draft navigation system. The cost of this work is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 448, Fifty-sixth Congress, first session. (See also Appendix W 19.)

6. *Preliminary examination and survey of Chocolate Bayou, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan for improvement at an estimated cost of $15,000. In his opinion, concurred in by the division engineer, the locality is worthy of improvement by the General Government as a component part of an inland light-draft navigation system. The cost of this work is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 445, Fifty-sixth Congress, first session. (See also Appendix W 20.)

7. *Preliminary examination and survey of Highland Bayou, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively. In his opinion the locality is not worthy of improvement by the General Government, and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 452, Fifty-sixth Congress, first session. (See also Appendix W 21.)

8. *Preliminary examination and survey of Bastrop Bayou, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan for improvement at an estimated cost of $20,000; but he states that in his opinion the locality is not worthy of improvement by the General Government at this time, and his views

are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 454, Fifty-sixth Congress, first session. (See also Appendix W 22.)

9. *Preliminary examination and survey of Oyster Creek, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively. The plan presented for improvement is estimated to cost $65,000 and involves the purchase of the Galveston and Brazos Canal at an additional cost of $50,000. Improvement of the locality is deemed by the local officer to be eminently advisable as a component part of an inland light-draft navigation system, and this view is concurred in by the division engineer. The cost of this work is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 447, Fifty-sixth Congress, first session. (See also Appendix W 23).

10. *Preliminary examination and survey of mouth of Brazos River, Texas, with estimates of the cost of extending the jetties one-half mile, of the depth and width of channel to be obtained by such extension, and of the cost of obtaining 20 feet of water and a channel 150 feet wide.*—Captain Riché submitted report dated April 18, 1900, and in compliance with requirements of the act he submits the following:

(*a*) Estimated cost of extending the jetties one-half mile, $1,100,000, in addition to $165,000 required under existing project for repairing and completing the present jetties, the estimate being based upon the supposition that the extension work can be placed under one contract.

(*b*) The extension of the jetties one-half mile would not of itself improve the channel, but if supplemented by dredging and a system of spur dikes to contract the channel to about 440 feet between jetties, estimated to cost $200,000, a channel depth of 20 feet and width of 150 feet could be practically constantly maintained by an expenditure of $30,000 annually.

(*c*) Estimated cost of obtaining 20 feet of water and a channel 150 feet wide: (1) By jetty extension, spur dikes, and dredging, $1,300,000, and $30,000 annually for maintenance, or (2) by dredging alone, $375,000, and $40,000 annually for maintenance.

In the opinion of Captain Riché, concurred in by the division engineer, the best method of improvement is by dredging alone.

The report was transmitted to Congress and printed in House Doc. No. 652, Fifty-sixth Congress, first session. (See also Appendix W 24.)

11. *Preliminary examination and survey of San Bernard River, Texas.*—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively. He presents a plan for improvement by jetties at an estimated cost of $300,000, and $5,000 annually for maintenance, but states that the river can be improved in another and more useful manner by connecting the river with Brazos River to the east and Matagorda Bay, via Caney Creek, to the west, the cost of the work being estimated at $270,000, exclusive of right of way, which, in the opinion of Captain Riché, should be donated by the owners. As a component part of an inland light-draft navigation system, the local officer is of opinion that the San Bernard is worthy of improvement by the General Government in the manner indicated, and his views are concurred in by the division engineer.

Plans for improvement of a number of streams in the vicinity of San Bernard River have been presented by Captain Riché in compliance with the requirements of the river and harbor act of March 3, 1899, and he states that their improvement can be contracted for much more advantageously by including them under one appropriation. He therefore presents a general estimate for work as proposed, viz, $450,000. This sum includes contingencies and $50,000 for purchase of the Galveston and Brazos Canal.

The reports were transmitted to Congress and printed in House Doc. No. 446, Fifty-sixth Congress, first session. (See also Appendix W 25.)

12. Preliminary examination and survey of Caney Creek, Texas.—Captain Riché submitted reports dated July 24, 1899, and January 24, 1900, respectively, with plan for improvement at an estimated cost of $20,000, the locality being considered by him to be worthy of improvement by the General Government as a component part of an inland light-draft navigation system, and his views are concurred in by the division engineer. The cost of this work is included in the general estimate of $450,000, embracing a number of works, contained in report on survey of San Bernard River (Appendix W 25). The reports were transmitted to Congress and printed in House Doc. No. 450, Fifty-sixth Congress, first session. (See also Appendix W 26.)

13. Preliminary examination of Colorado River, Texas, from its mouth to the foot of the great raft.—Captain Riché submitted report dated October 20, 1899. It is his opinion, concurred in by the division engineer, and by me, that the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 57, Fifty-sixth Congress, first session. (See also Appendix W 27.)

14. Preliminary examination for canal around the raft in Colorado River, in Matagorda County, Tex.—Captain Riché submitted report dated July 24, 1899. In his opinion, concurred in by the division engineer, and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 134, Fifty-sixth Congress, first session. (See also Appendix W 28.)

15. Preliminary examination of harbor at Alligator Head, in Matagorda Bay, Texas.—Captain Riché submitted report October 20, 1899. He is of opinion that the locality is not worthy of improvement by the General Government at the present time and his views are concurred in by the division engineer, and by me. The report was transmitted to Congress and printed in House Doc. No. 71. Fifty-sixth Congress, first session. (See also Appendix W 29.)

16. Preliminary examination of harbor at Brazos Santiago, off Point Isabel, Texas.—Captain Riché submitted report October 19, 1899. In his opinion, concurred in by the division engineer, and by me, the locality is not worthy of improvement by the General Government in the manner indicated at the present time. The report was transmitted to Congress and printed in House Doc. No. 60, Fifty-sixth Congress, first session. (See also Appendix W 30.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Trinity River, Texas, from the city of Dallas to the city of Fort Worth, with a view to securing a navigable depth of 4, 5, and 6 feet, respectively.*
2. *Galveston Bay, Texas, with a view to widening, deepening, and extending the present channel from a point where it now is of sufficient width and depth to a point opposite Twentieth street; thence to a point opposite Thirty-fifth street; thence to a point opposite Fifty-first street, with a report as to the relative importance of the respective sections.*
3. *Galveston, Tex., inner harbor.*
4. *Brazos River, Texas, from its mouth to the city of Waco, with a view to procuring a navigable depth of 4, 5, and 6 feet, first, from its mouth to the town of Old Washington, in Washington County; second, from said town of Old Washington to the city of Waco.*

WESTERN RIVERS.

IMPROVEMENT OF CERTAIN RIVERS AND WATERWAYS IN LOUISIANA, TEXAS, ARKANSAS, AND MISSISSIPPI TRIBUTARY TO MISSISSIPPI RIVER; WATER GAUGES ON MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES.

This district was in the charge of Maj. J. H. Willard, Corps of Engineers, to December 29, 1899, and of Maj. Thomas L. Casey, Corps of Engineers, since that date. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Red River, Louisiana, Arkansas, and Indian Territory.*—This improvement was begun in 1828, and appropriations aggregating $535,765.50 were made between 1828 and 1852. Between 1841 and 1852 no appropriation was made, and a longer interval elapsed between 1852 and 1872, during which the results of former work were lost.

The present improvement commenced in 1872. At that time the river above Shreveport, La., was closed by the great raft, 32 miles long and increasing with each flood; below Shreveport the river was affected seriously by the gradual enlargement of Tones Bayou outlet, which depleted the main channel and threatened its closure to navigation; the falls at Alexandria were impassable at low stages; snags, stumps, sunken logs, and leaning timber rendered navigation difficult and dangerous the entire length of the river, and more than a hundred steamboat wrecks lay in the channel between Fulton, Ark., and the mouth.

The project adopted in 1872 contemplated removing the raft and closing Tones Bayou. It has been amplified since to include the removal of jams, snags, wrecks, leaning timber, etc.; opening and enlarging the channel through the falls at Alexandria, deepening shoal places, closing outlets, and fixing caving banks; to improve and keep navigation open from the head of Atchafalaya River, Louisiana, to Fulton, Ark., 508.6 miles. The nature of the work requires that it be continued for many years, and no estimate for completion is given on this account. The river and harbor act of March 3, 1899, provided for extending work above Fulton to mouth of Kiamichi River, Indian Territory, previously carried on under separate appropriations.

The river and harbor acts of July 13, 1892, and August 18, 1894, provided that work under the appropriations of these acts for Red River should be carried out in accordance with the plan of Maj. J. H.

Willard, Corps of Engineers, the officer in local charge of the work. Major Willard's plans included the "construction of a substantial system of levees to restrain the greatest floods, either alone or in partnership with the riparian States." The construction of levees was begun by the United States in 1892, in conjunction with the State of Louisiana and local levee districts, in accordance with what was understood to be the will of Congress as expressed by the wording of the item of appropriation. In the succeeding five years the United States built, under appropriations of 1892, 1894, and 1896, 12.54 miles of new line and repaired and enlarged 5.74 miles of old work, containing 1,275,344 cubic yards, at a cost of $182,856.06.

The amount expended from 1872 to June 30, 1899, was $1,409,009.95, with the following results: In the old raft region there flowed in the course marked out for it a broad and deep river, safe at all but the lowest stages, with a channel constantly scouring, the bottom having gone down as much as 15 feet, and the low-water line following it to a certain extent. In addition to opening hundreds of miles of navigable waterway, the removal of the raft drained the great valley of the river and reclaimed thousands of acres of productive lands. Tones Bayou outlet was closing gradually, and the main channel below had widened and scoured until it carried the greater portion of the discharge at flood, and navigation of the stretch formerly impaired by the outlet was uninterrupted at the lowest stages. The falls at Alexandria had been made passable the year round, an increase of about two months in the period of navigation. Persistent snagging operations, repeated from time to time, kept the river open, prevented formation of raft, reduced the dangers of navigation to a minimum, and enabled steamboats to make regular trips. At very low stages, say barely a foot above zero on the Shreveport gauge, the river was open to boats of 3 feet draft from the Atchafalaya to Fulton.

In the fiscal year ending June 30, 1900, snagging operations, etc., for general improvement of the river were continued by the U. S. snag boat *C. W. Howell* from July 1 to January 12, and extended from a point about 6 miles above Fulton, Ark., to head of Atchafalaya River, Louisiana, over a stretch of river 515 miles in length. After suspension of this work, the *Howell* and the smaller snag boat *Thos. B. Florence*, were sent up the Mississippi River to undergo extensive repairs of iron bottoms, etc., essential to continuing them in service; the *Howell* never having been in dock since she was built in 1881 and the last extensive repairs of the *Florence* having been made in 1884. The bottoms of both vessels are to be renewed with five-sixteenth-inch steel plates, new boilers are to be procured, and other necessary repairs made. This work is in progress at Dubuque, Iowa.

Tones Bayou outlet was closed in October, 1899, by a heavy earthen dam with wing walls connecting with the levees above and below; the work was done by cooperating with the State engineer of Louisiana, the United States paying $2,195.80, not quite one-third of the total cost.

Under an allotment from the appropriation by act of March 3, 1899, approved by the Secretary of War July 5, 1899, the construction of levees was continued as follows: Scott Slough Levee along right bank of Red River in Caddo Parish, La., 129.2 to 132.3 miles below Fulton, was completed by the United States February 2, 1900. It is an extension upstream 10,205 feet of the Hervey Canal Levee, completed May

18, 1899, and contains 251,511 cubic yards of embankment, which cost 21.84 cents per cubic yard. The Choctaw Bayou Levee, completed January 1, 1899, along right bank of Red River in Avoyelles Parish, La., 432¼ to 437.3 miles below Fulton, having been damaged by heavy rains and the grass killed by excessively cold weather and subsequent drought, was repaired in October, 1899, the slopes restored to original grade, and the line resodded, at a cost of $2,547.

The estimate of $135,000 presented is for repairs of and additions to plant, surveys, snagging work, and contingencies, but does not include an estimate for levee work.

The officer in local charge submits in his report an additional estimate of $550,000 for the construction of levees. It is respectfully recommended that such an amount as Congress may consider proper for expenditure for levee construction as a part of the improvement of the Red River may be appropriated or allotted separately from the appropriation or allotment for other items of improvement. The construction of levees on the Red River has been heretofore carried on under the assumption that Congress has by the wording of the item approved of such work; but it appears proper that, if such work is approved of by Congress as a part of the improvement of Red River, the instructions as to the work should be definite.

The amounts expended during the year and balances July 1, 1900, were as follows:

Allotments.	Expended during year.	Balance July 1, 1900.
For general improvement, repairs, and care of plant, etc	$14,931.54	$78,601.03
For Little River, from Scopini Cut-off to Knox Point (act September 19, 1890)	2,241.82	4,171.81
For construction of levees	60,530.16	3,002.68
For Sulphur River (act August 18, 1894)		2,511.01
For Red River above Fulton, Ark. (act June 3, 1896)	516.18	1,539.37
Total	78,219.70	89,825.90

It is recommended that legislative action be taken to transfer the balance of allotment for Little River to the allotment for general improvement. The stretch between Scopini Cut-off and Knox Point, 17½ miles long, called Little River, can be kept in good navigable condition by following the adopted plan of occasional work in connection with the general improvement, or work at any special point when required for the immediate needs of commerce; but as the act of September 19, 1890, directed that the funds should be used in deepening and widening Little River, the transfer can not be made until authorized by Congress.

The commerce of Red River consists chiefly of large shipments of cotton, cotton seed and its products, lumber, staves, saw logs, etc., with heavy return freights of general merchandise and plantation supplies. The business of the river for the past eleven years, as reported and compiled for comparison in the report of the district officer, shows great variations from year to year (probably due to crop conditions, periods of very low water, and other causes), ranging in quantity from 66,376 to 228,630 tons per annum, with estimated values of from $3,419,000 to $9,185,000. The average for the eleven years is 104,397 tons, valued at $5,295,000. To this should be added the commerce of Ouachita River, entering Red River at mouth of the Black, the annual average of which is 155,523 tons, valued at $5,888,000, making a total of 259,920 tons, valued at $11,183,000.

July 1, 1899, balance unexpended		[1]$168,045.60
June 30, 1900, amount expended during fiscal year		78,219.70
July 1, 1900, balance unexpended		89,825.90
July 1, 1900, outstanding liabilities	$85.49	
July 1, 1900, amount covered by uncompleted contracts	16,860.00	
		16,945.49
July 1, 1900, balance available		72,880.41
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		135,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix X 1.)

2. *Red River above Fulton, Ark.*—Before work commenced this part of Red River was obstructed by snags and piles of drift, rendering navigation difficult and hazardous. The project adopted in 1886 contemplated removal of these obstructions, to afford reasonably safe navigation at high stages to the mouth of Kiamichi River, Indian Territory, about 138 miles above Fulton.

The project of 1886 was completed in 1891, at a cost of $11,774.89. Subsequent appropriations were applied to maintenance of the work, the total amount expended to June 30, 1899, having been $19,944.45.

May 13–31, 1899, the U. S. snag boat *Columbia* worked above Fulton, for a distance of about 65 miles, removing snags, etc., obstructing navigation.

The commerce of this part of Red River is insignificant, and the work done has had no perceptible effect toward increasing it. It consists chiefly of logging, with occasional shipments of cotton, seed, and plantation supplies when boats run above Fulton. The chief benefit to be derived from further work is that it will lessen the source of drift for which Red River is noted. The river and harbor act of March 3, 1899, provides for continuing operations under the general title improving Red River.

July 1, 1899, balance unexpended	$2,055.55
Amount taken up under appropriation for improving "Red River, Louisiana, Arkansas, and Indian Territory"	2,055.55

3. *Cypress Bayou, Texas and Louisiana.*—Cypress Bayou evidently was an unnavigable stream until the advance of the Red River raft above Shreveport had converted its bottom lands into reservoirs known as Fairy, Sodo, and Cross lakes. Before the work for its improvement between Shreveport, La., and Jefferson, Tex., commenced, navigation was difficult and dangerous by reason of bars and leaning timber in the bayou proper, and snags, stumps, fallen timber, and sunken logs in the channel through the lakes.

The project adopted in 1872 contemplated straightening the channel and dredging bars in Cypress Bayou, to give uniform depth, and the removal of overhanging trees, shore snags, etc., opening and enlarging the entrance of the bayou into the head of Fairy Lake by dredging, removing stumps, snags, sunken logs, and timber from the channel selected down the lakes, and snags, leaning trees, etc., in Twelve-mile Bayou.

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[1] Includes $2,055.55 reported in 1899 under head of "Red River above Fulton, Ark."

The project of 1872 was completed in 1880 at a cost of $94,000, but the temporary character of the work required it to be repeated at intervals for maintenance. The removal of the Red River raft and the closure of outlets and construction of levees along the right bank of that stream reduced the water supply and caused the lakes to drain more rapidly, shortening the period of navigation. Congress ordered a survey, completed in 1893, to determine if navigation could be improved permanently by locks and dams, but a plan for such improvement was not entered upon. The river and harbor act of 1894, however, appropriated $10,000 "for dredging and removing obstructions and straightening channel between Jefferson, Tex., and Shreveport, La.," and the act of 1896 appropriated $5,000 "for continuing improvement." The project for expenditure of these amounts was approved June 14, 1897.

Immediately after approval of the project for continuing this improvement an elevator dredge belonging to the plant of this district was towed to Shreveport, La., for use in carrying out the requirements of the acts making the appropriations, but in the last 3 years there has been no stage sufficient for it to cross the flats at the lower end of Sodo Lake to do the work proposed.

In the fiscal year ending June 30, 1899, during the period of lowest water—August to November—a party equipped with tools, tackle, and explosives worked over the route from Jefferson to Shreveport, removing stumps, snags, logs, leaning timber, etc., and marking the channel through the lakes with signboards.

The total amount expended to June 30, 1899, was $138,237.07. The balance available was reserved for dredging and straightening the channel in accordance with the purpose designated in the appropriations, but no work of the kind could be done for the reason stated above.

The work done since 1886 had no permanent effect upon the commerce between Jefferson and Shreveport, which dwindled to insignificance and then ceased altogether as the periods of navigation became shorter and shorter. The maintenance of an expensive work to give navigation between the two places doubtless would act more as a check upon freight rates than as a means of transportation.

July 1, 1899, balance unexpended	$7,464.26
June 30, 1900, amount expended during fiscal year	843.30
July 1, 1900, balance unexpended	6,620.96

(See Appendix X 2.)

4. Ouachita and Black rivers, Arkansas and Louisiana.—The improvement of Ouachita River was commenced in 1871. Black River, 56 miles long, connecting Ouachita with Red River, was added under the same head of appropriation by act of 1884. The original project contemplated temporary improvement of the Ouachita from Arkadelphia, Ark., to Trinity, La., by removal of snags, etc., and dredging the worst bars. In 1872 a project for improvement by locks and dams was entered upon, but it was abandoned in 1874 for various reasons, the chief one being that the locks would be idle at the time intended for use until a permanent improvement should be obtained at the mouth of Red River. The project under which work has continued since 1874 contemplates the removal of snags, logs, wrecks, leaning timber, etc., below Camden, Ark., 350 miles above the mouth of Black River, and the improvement of shoal places by dams and dredging. No estimate of cost is given, as the nature of the work requires that it be continuous.

The total amount expended to June 30, 1899, was $506,728.13. The amount expended under the project of 1874 was $375,432.44. The iron-hull snag boat *Wagner* was purchased for the work in 1875 and the small wooden snag boat *Columbia* in 1888. Operations were carried on whenever funds were available and conditions favorable, and consisted chiefly of removing snags, logs, wrecks, and tree slides in the channel and leaning timber along the banks. An increased depth was gained at some shoals in the upper river by wing dams of stone and brush, the temporary effect of which, however, has been lost. Catahoula Shoals, a rock and gravel bar 20 miles above Trinity, formerly much complained of by steamboat men, were improved permanently by dredging, etc., finished in 1895. To comply with requirement of the act of 1894, a survey was commenced for the purpose of preparing plans and estimates for improvement by locks and dams.

During the fiscal year ending June 30, 1900, operations were continued as follows: July 1 to February 23 the U. S. snag boat *O. G. Wagner* worked over the river from Mallard Lake, about 51 miles above Monroe, La., to mouth of Black River, a reach 225 miles in length, removing snags, logs, stumps, wrecks, etc., obstructing navigation, and during the period of lowest water, October 11 to December 22, operations of the snag boat were supplemented in the shoal stretch of 86 miles below the mouth of Bayou Bartholomew to Columbia, La., by a party equipped with tools, tackle, and explosives, which performed effective work in the way of clearing the banks and channel of obstructions and destroying those which had lodged upon sand bars.

Office and field work of the survey were continued during the year, but all of the data required for a complete and comprehensive report upon a project for improvement by locks and dams had not been acquired. In response to a call from this office, the officer in charge submitted a preliminary report February 7, 1900, giving the progress of the work, in which it was estimated that thirteen locks and dams will be required to maintain navigation the year round from Red River to Camden, the cost of which will be approximately $3,575,000, exclusive of the cost of maintenance and repairs.

The amounts expended during the year and balances July 1, 1900, were as follows:

Allotments.	Expended during year.	Balance July 1, 1900.
For general improvement, repairs, and care of plant	$18,272.62	$18,662.62
For survey	22,377.82	46.458.81
Total	40,650.44	65,121.43

The commerce of Ouachita River and its tributaries is considerable, consisting of shipments of cotton, cotton seed, lumber, saw logs, staves, and miscellaneous articles, and return freights of general merchandise, plantation supplies, etc. Most of the cotton goes direct to New Orleans, and large quantities of staves are shipped to that city each year for export. The business of the past eleven years, as reported to and compiled for comparison in the report of the district officer, ranges from 73,679 to 239,197 tons per annum, with values estimated at $3,293,000 to $10,234,250. The average for the eleven years is 155,523 tons, valued at $5,888,000.

July 1, 1899, balance unexpended	$105,771.87
June 30, 1900, amount expended during fiscal year	40,650.44
July 1, 1900, balance unexpended	65,121.43
July 1, 1900, outstanding liabilities	1,099.30
July 1, 1900, balance available	64,022.13
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	40,000.00

(See Appendix X 3.)

5. *Bayou Bartholomew, Louisiana and Arkansas.*—Before this improvement was commenced by the United States the bayou was so obstructed by snags, logs, wrecks, leaning timber, etc., that it was navigable for light-draft boats at high stages only, or for about three months in the year, and even during that short period the passage was slow, difficult, and dangerous.

The project entered upon in 1881 contemplated removing the obstructions to give safe navigation, and extend the period thereof, between the mouth and Baxter, Ark., about 150 miles above.

After sixteen years' work with small and intermittent appropriations, the project of 1881 was practically completed in 1897 as far upstream as McComb Landing, Ark., the present head of navigation, about 135 miles above the mouth, at a cost of $45,873.53. This work resulted in safer navigation, increasing the period to about six months of the year, enabling larger boats to make trips in half the time formerly required, and reducing freight rates about one-half. There being no demand for navigation above McComb Landing, subsequent expenditures were for maintenance of the improvement, the sum of $2,092.17 having been applied to that purpose to the close of the fiscal year ending June 30, 1899, making the expenditures to that date aggregate the sum of $47,965.70.

During the period of lowest water in the fiscal year ending June 30, 1900 (July 6 to October 10, 1899), the bayou from McComb Landing to its mouth was worked over by a force of laborers, equipped with tools, tackle, and explosives; the obstructions added during the two years preceding were removed, and the stream put in good navigable condition for the time being.

Drift, caving and sliding banks, and the rapid growth of vegetation constantly add new obstructions, which accumulate more rapidly and become more difficult to remove each year. The annual cost of maintaining unobstructed navigation at stages on which steamboats can run is estimated at $2,500. No provision for maintenance during the fiscal year ending June 30, 1901, having been made, the cost of the work required during the succeeding year probably will be about $5,000.

The country along Bayou Bartholomew is very productive and well settled, but of late years much of the trade has been diverted to the railroads, the stages of the bayou (formerly the only way of shipment) frequently not being coincident with the needs of transportation. The river trade consists of shipments of cotton, cotton seed, saw logs, staves, and miscellaneous articles, with return freights of general merchandise and plantation supplies. In the last eleven years the freights reported annually range between 6,633 and 49,299 tons, with values estimated at $136,000 to $826,000, varying widely according to crop conditions and periods of navigation. The average for the eleven years is 15,697 tons, valued at $384,500.

July 1, 1899, balance unexpended	$4,034.30
June 30, 1900, amount expended during fiscal year	3,247.72
July 1, 1900, balance unexpended	786.58
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix X 4.)

6. *Bœuf River, Louisiana.*—The improvement of this stream was undertaken by the State of Louisiana more than half a century ago. Before work commenced by the United States it was navigable to Point Jefferson, La., at high water, but passage was difficult and dangerous on account of overhanging timber, snags, and logs.

The project adopted in 1881 contemplated removing obstructions to afford safe navigation at high stages from the mouth to Wallace Landing, about 152 miles above. The closure of three outlets near Point Jefferson, to confine the flow to the main channel, was added to the project in 1886.

The amount expended to June 30, 1899, was $48,936.91.

The project for removing obstructions to give safe navigation at high stages was completed in 1896, but the work is not permanent, new obstructions being constantly added by drift, sliding and caving banks, and the rapid growth of timber along the banks. About $2,500 a year is required for maintenance.

The three outlets near Point Jefferson were closed as securely as possible with the funds available in 1887–88, and their closure gave immediate benefit to navigation by confining the flow to its natural course and scouring the bars below. The dams were destroyed during the overflow from the Mississippi River in 1890, caused by breaks in the Arkansas levees near the head waters of Bœuf River, and funds have not been provided for their restoration. Soundings in 1896 showed a very considerable shoaling below the outlets. The estimated cost of the work required for closing them substantially is $30,000.

No work was done during the fiscal year ending June 30, 1900.

Of the funds available, $2,500 has been alloted for maintenance of improvement. It will be unwise to attempt to close the outlets near Point Jefferson until funds are available to do all the work required without delay, and for this reason it is not proposed to expend the balance available at present.

The commerce of Bœuf River consists of shipments of cotton, cotton seed, large quantities of staves sent to New Orleans for export, and miscellaneous articles, with return freights of general merchandise and plantation supplies. The business reported for the last eleven years varies between 2,435 and 11,261 tons, with estimated values ranging from $69,000 to $636,500 per annum, the average being 6,856 tons, valued at $297,000.

July 1, 1899, balance unexpended		$12,063.09
July 1, 1900, balance unexpended		12,063.09
Amount (estimated) required for completion of existing project		20,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$20,500.00	
For maintenance of improvement	2,500.00	
		23,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix X 5.)

7. *Tensas River and Bayou Maçon, Louisiana.*—These streams were navigable at high stages before work was undertaken by the United States, but passage of steamboats was difficult and dangerous on account of leaning timber and snags, logs, etc., in the channel. The project for improving Tensas River, adopted in 1881, contemplated removing obstructions between the mouth and Dallas, about 134 miles above, at an estimated cost of $23,000. Bayou Maçon, the principal commercial branch, was added under the same head of appropriation by act of 1884, and the project contemplated the same class of work between its junction with Tensas River and Floyd, about 98 miles above, at an estimated cost of $17,000.

The amount expended to June 30, 1899, was $35,862.44, of which sum $11,947.02 was applied to Tensas River and $23,915.42 to Bayou Maçon. With these expenditures Bayou Maçon to Floyd and Tensas River to Westwood Place, about 75 miles above its mouth, were put in fairly good navigable condition at medium and high stages for the time.

No work was done during the fiscal year ending June 30, 1900, but it is proposed to apply the available funds to maintenance of what has been accomplished since 1881 during the period of low water this summer and autumn.

Upper Tensas River, above Westwood Place to Dallas, is practically unnavigable and there has been no demand for its improvement until within the last year, when efforts were made to induce resettlement of the deserted plantations along its banks and to secure the improvement to Dallas contemplated by the project of 1881.

The original plans were for completing work during one season of low water at a cost of $40,000. The total of the small appropriations made at intervals during the past nineteen years is $40,000. If work is to continue it is estimated that about $2,500 per annum will be required for some years to come to maintain what has been done since 1881.

The commerce of the river and bayou consists chiefly of shipments of cotton, cotton seed, staves, etc., with return freights of plantation supplies and general merchandise. The business as reported for the last eleven years ranges from 2,649 to 23,605 tons per annum, with values estimated at $122,500 to $999,500. The average for the eleven years is 14,106 tons, valued at $564,500.

July 1, 1899, balance unexpended	$4,137.56
July 1, 1900, balance unexpended	4,137.56
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix X 6.)

8. Yazoo River, Mississippi.—Prior to improvement navigation of this river was obstructed by wrecks of gunboats, steamers, etc., sunk to prevent passage during the war of the rebellion, and by a great number of snags, stumps, tree slides, and sunken logs in the channel, and a heavy growth of leaning timber along the banks.

Nine wrecks were removed by contract in 1873–74, and the latter year a project was made to clear the river thoroughly of obstructions then existing, in a period of four years, at a cost of $120,000, annual appropriations to be made thereafter for maintenance of the work. The appropriations made were not sufficient to carry out this plan, and work has continued from time to time under a project for the removal of wrecks, snags, logs, leaning timber, etc., so far as the funds provided will permit. Floods, sliding and caving banks, leaning timber, and the rapid growth of vegetation along an alluvial stream of this character add new obstructions to navigation continually, and snagging operations, etc., should continue from year to year in the interest of safe and uninterrupted navigation.

The amount expended to June 30, 1899, was $262,497.37. The results of the work were marked. The large number of wrecks that blocked the channel at low stages and limited the period of navigation had been removed so as to present no obstruction, and the removal of snags, logs, leaning timber, etc., repeated from time to time, opened and maintained steamboat navigation from mouth to head of the river the year round.

The small wooden snag boat *Columbia* performed about three weeks' work for the removal of obstructions to navigation during the period of low water in September and December, 1899, operations extending from Belcher Bar, about 40 miles above the mouth, to the head of the river. For lack of plant nothing further was done during the fiscal year ending June 30, 1900. After suspension of work by high stages the hull of the *Columbia* was rebuilt, under authority from this office, and the boat prepared for service in Yazoo River and tributaries this summer and autumn.

The U. S. snag boat *John R. Meigs*, used upon this work and other streams of the district since it was built in 1879, was transferred in April, 1898, for temporary service upon the defensive works at the entrance to Mississippi River as a war emergency, and was employed in placing and raising torpedoes. The boat was blown up by the accidental discharge of a torpedo September 3, 1898, and sunk in deep water near Fort St. Philip, La. A new snag boat, to replace the *Meigs*, is much needed for continuing work in Yazoo River and tributaries, and when not so employed it can be used to advantage elsewhere in the same district. The cost of a new steel boat, equipped for service, is estimated at $60,000, or about 20 per cent less than the first cost of the *Meigs*. It was not believed that a transfer of funds from the war fund to replace the snag boat was permissible under the law, but it is recommended that the next appropriation contain an allotment for the purpose.

Work in Yazoo River and its tributaries could be carried on with greatest economy and the best results obtained if the streams were grouped as a system under one general head, and with this view the appended estimate is made. If sufficient plant is acquired, and the work thoroughly done, the cost of maintenance should decrease each year.

The river and harbor act of August 11, 1888, contained an appropriation of $32,000 for improving Yazoo River, and provided that of this sum $8,000 should be used for constructing a pumping dredge boat. An unexpended balance of $2,036.14 of this allotment for constructing the pumping dredge remains unexpended and is not required for the purpose named in the act.

The acts of August 18, 1894, and June 3, 1896, each provide, in the item of appropriation for Yazoo River, for application of a portion of the funds provided to removing bar at Yazoo City. This provision was not inserted in the acts upon recommendation of this office, and the officer in charge has stated that the survey made in June, 1896, confirms his opinion that removal of the bar at Yazoo City would impair the navigation of the river at and above the bar. For the above reasons, and for the further reason stated by the engineer officer recently in charge of the district that the sentiment of such citizens as expressed themselves on the subject was decidedly adverse to the removal of the bar on the city front, I suggest that the provisions of the acts of 1894 and 1896 touching removal of this bar be repealed.

The commerce of Yazoo River and tributaries, as reported for the past ten years, ranges between 102,098 and 254,235 tons annually, with values estimated at $2,840,000 to $8,314,000. The average for the ten years is 193,841 tons, valued at $5,052,000. The chief shipments are cotton, cotton seed, lumber, staves, etc., and return freights of general merchandise and plantation supplies.

July 1, 1899, balance unexpended	$32,502.63
June 30, 1900, amount expended during fiscal year	7,984.16
July 1, 1900, balance unexpended	24,518.47
July 1, 1900, outstanding liabilities	1.08
July 1, 1900, balance available	24,517.39
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	90,000.00
Submitted in compliace with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix X 7.)

9. *Mouth of Yazoo River and harbor at Vicksburg, Miss.*—The shifting bar at mouth of Yazoo River is the most serious obstruction to navigation of that river and its tributaries, a system of about 800 miles of navigable waterways. At low stages steamboats are prevented from entering or leaving the river without lightering, and frequently navigation across the bar is closed entirely at the busiest season of the year. A survey with a view to giving free passage the year round for vessels engaged in navigation of the river was directed by river and harbor act of 1890, and the plan based thereon contemplated making a

new mouth or outlet for the river from the former mouth of Yazoo, on Old River, about 9.8 miles above present mouth, through the deep water in Old River, across the neck of low land between Long and Barnett lakes to Lake Centennial, and thence down Lake Centennial, around the head of De Soto Island and along the front of Vicksburg, entering Mississippi River on the channel side at Kleinston Landing. Vicksburg Harbor is that part of the old channel of the Mississippi cut off in 1876 and now known as Lake Centennial, in front of the city and extending down to Kleinston.

The original estimate of cost of the work required was $1,500,000, but was revised in 1893 and reduced to $1,200,000, upon a basis of completion in three years. The project was entered upon by the United States in the river and harbor act of 1892, which provided $75,000 for beginning work, and the act of 1894 contained appropriations of $265,000 for continuing the improvement. The sundry civil act of June 4, 1897, appropriated $350,000 for the work, making the total sum appropriated $690,000.

The river and harbor act of June 3, 1896, appropriated no money, but provided for completing the work, as follows:

> Improving mouth of Yazoo River and harbor of Vicksburg, Mississippi: For the purpose of completing the project of improvement as heretofore adopted and entered upon, in addition to expending the balance on hand, contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the same, or said materials may be purchased and work may be done otherwise than by contract to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and sixty thousand dollars, exclusive of the amount heretofore appropriated.

The amount expended to June 30, 1899, was $178,509.86. The surveys and maps were finished. The final line selected for the main cut between Old River and Lake Centennial was marked, and under authority from the Secretary of War the right of way, aggregating 1,155.54 acres, was acquired by purchase, at a cost of $34,254.68, or an average price of $29.64 per acre; and jurisdiction over the lands was ceded the United States by the State of Mississippi. Borings were made to determine the character of the material to be excavated. The entire route from Old River to Kleinston Landing was cleared, grubbed, and all logs, stumps, and débris were burned or removed from the right of way, a considerable amount of the felled timber having been cribbed and towed into Lake Centennial, to be sunk as a foundation for the dam across the west arm. A base for future levels along the whole line from Old River to Kleinston was measured with steel tape, and reference points were established at intervals of 164 feet. Barnett Lake was drained by a ditch sufficiently to permit the removal of stumps from its bed. To enable dredges to work over elevated portions of the main cut at high stages, and also to permit towing logs from the right of way, the higher ground near both ends of the land cut was lowered by scraper work under two contracts, 277,709 cubic yards of earth having been excavated in that way, and the material placed in continuous embankments along both sides of the route.

June 14, 1899, a contract was let for excavating 7,500,000 cubic yards of earth along the diversion route from Old River to Kleinston, subject to an increase or decrease of 25 per cent, under the continuous method specifically authorized in the river and harbor act of June 3, 1896, at the rate of 8.49 cents per cubic yard. The contract required that work should commence December 5, 1899, progress at a minimum rate of

260,000 cubic yards a month for six months, after which the rate of progress was to be increased to 330,000 cubic yards a month. Provision was made that if work commenced before December 5, 1899, the plant first put in operation should have an assured capacity of 65,000 cubic yards per month. The contractors commenced work September 2, and continued until December 20, 1899, removing 73,106 cubic yards during that period, or 28 per cent of the minimum output required for preliminary operations under the contract. One extension of 50 days' time was granted in which to prepare plant for full output, but no work was done after December 20. The contractors made further applications for time of varying periods which were denied, and under authority of the Secretary of War the contract was annulled March 7, 1900.

The work was readvertised May 28, 1900, and bids were opened June 28, the lowest having been at the rate of 12.4 cents per cubic yard.

As a part of the project to maintain favorable stages for dredging in Lake Centennial, the West Pass outlet of the lake into the Mississippi River was closed in July and August, 1899, by a heavy earthen dam, built by hired labor immediately after delivery of the contractor's plant in the lake. In January, 1900, before the period of high water, the dam was strengthened by the construction of a willow mattress to protect it from sloughing or scour.

Under authority of the Secretary of War the Mississippi River Commission's hydraulic dredge *Gamma* was employed from April 4 until May 10, 1900, dredging in Vicksburg Harbor, and removed 42,100 cubic yards of earth from the canal during that period.

The commerce of Yazoo River and tributaries, as reported for the past ten years, averages 193,841 tons, valued at $5,052,000, per annum. Statistics of the commerce of the mouth of Yazoo River and Vicksburg Harbor have been collected as far as practicable for the past five years, and compiled for comparison in the report of the district officer. The average of the entire commerce reported for the five years is 303,466 tons, valued at $7,922,000, per annum.

July 1, 1899, balance unexpended	$511,490.14
June 30, 1900, amount expended during fiscal year	23,895.17
July 1, 1900, balance unexpended	487,594.97
July 1, 1900, outstanding liabilities	611.15
July 1, 1900, balance available	486,983.82
Amount (estimated) required for completion of existing project	510,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	510,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix X 8.)

10. Tallahatchie River, Mississippi.—Before this work was undertaken the river was navigable to Sharkey, about 65 miles above the mouth, for six months of the year, but passage for steamboats was difficult and dangerous. Above Sharkey a heavy growth of leaning timber rendered the stream nearly impassable at all stages. The project contemplated removing the wreck of the ocean steamship *Star of the West*, sunk during the war of the rebellion, 8 miles above the mouth, and snags, sunken logs, leaning timber, etc., to give ease and safety to navigation from head of Yazoo River to mouth of the Coldwater, about

100 miles above. It was proposed to do the work then required in two seasons, at a cost of $40,000.

The improvement was authorized and entered upon by an appropriation of $6,000, contained in river and harbor act of March 3, 1879. The expenditures during the succeeding twenty years to June 30, 1899, aggregated $50,500; but of this sum $10,000 was applied to the stretch above the mouth of Coldwater River to Batesville, as required by provisions of the acts of 1880, 1881, and 1882. The work could not be done thoroughly, as planned in 1879, because the appropriations only permitted expenditures for work below mouth of Coldwater River at an average rate of $2,131 a year, but it has benefited navigation considerably, enabling steamboats to run to Sharkey the year round and to Coldwater River at moderately high stages.

During the period of lowest water in the fiscal year ending June 30, 1900, the small wooden snag boat *Columbia* was employed in this river between its mouth and Sharkey, performed thorough and effective work for the benefit of navigation at low stages, and put that stretch of the river in good temporary navigable condition.

New obstructions are brought into the river every year by drift and sliding and caving banks, and the shifting and scouring of the channel from time to time disclose snags and logs imbedded in the bottom or lodge them upon bars. It is estimated that it will require an expenditure of $10,000 in one working season to put Tallahatchie River between Yazoo and Coldwater rivers in fairly good navigable condition, in accordance with the original plan, and that about $2,500 a year will be necessary for maintenance for some time to come. The project was modified to include these estimates March 21, 1899.

The commerce of Tallahatchie River consists chiefly of shipments of cotton, cotton seed, and timber, with return freights of general merchandise and plantation supplies. The totals reported for the past ten years range between 22,132 and 92,817 tons per annum, with values estimated at $735,000 to $2,428,000 per annum; the average for the period being 49,411 tons, valued at $1,489,000.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	2,200.59
July 1, 1900, balance unexpended	2,799.41
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix X 9.)

11. Big Sunflower River, Mississippi.—Before the improvement of this river commenced navigation was badly obstructed by snags, sunken logs, leaning timber, sand bars, and shoals. The low-water channel at many places was so filled with logs as to give no greater depth than 18 inches, and so narrow as to afford passage for the smallest boats only. Leaning timber obstructed navigation at all stages, and Oliphant Bar, extending from the mouth upstream 15 miles, and Muscle Shoals, 5 miles long, beginning about 30 miles above the mouth, had depths at low water ranging from 17 to 24 inches.

The amount expended to June 30, 1899, was $72,721.19. Before work commenced there was navigation for light boats about six months of the year. The work done has enabled boats to run to Woodburn, 77 miles above the mouth, the year round, and at ordinary stages to make the trip in little more than half the time formerly required. Passage was difficult and dangerous at low stages. Faisonia, about 100 miles above the mouth, was considered the head of navigation. Freight rates were said to have been reduced 50 per cent.

During the fiscal year ending June 30, 1900, the snag boat *Columbia* spent two and one-half months, July 1 to September 16, 1899, during the period of low water, in removing the obstructions to navigation between the mouth and Chicosa, a few miles above Woodburn, putting that stretch of the river in good navigable condition for the time.

The original plan for this improvement contemplated work during three to four consecutive seasons of low water, for the removal of leaning timber and obstructions in the channel, and the building of inexpensive wing dams to scour a depth of about 40 inches on the bars, at a probable cost of $66,000; operations to extend to Clarksdale, about 180 miles above the mouth. Congress entered upon the project by act of March 3, 1879; within three years $37,000 was appropriated, and fairly good progress was made. Since 1882 each river and harbor act has appropriated $5,000 for continuing the improvement, allowing an average sum of $2,500 per annum for expenditure. As new obstructions are added every year by the rapid growth of vegetation along the banks and by floods, caving and sliding banks, etc., it was not practicable to carry out the original plan with the funds provided, and the appropriations since 1882 have been applied chiefly to maintaining what was accomplished during the first four years. It is estimated that an expenditure of about $20,000 in one or two seasons of low water will be required to complete the work, after which about $3,000 annually will be needed for maintenance. Authority to modify the project by including these estimates was granted March 21, 1899.

The commerce of this river consists of shipments of cotton, cotton seed, staves, and miscellaneous articles, with return freights of plantation supplies, general merchandise, etc. The quantities reported annually for the past eleven years vary between 8,931 and 53,222 tons, with values estimated at $251,000 to $1,457,000. The average for the eleven years is 32,258 tons, valued at $970,000.

July 1, 1899, balance unexpended	$4,278.81
June 30, 1900, amount expended during fiscal year	3,563.73
July 1, 1900, balance unexpended	715.08
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix X 10.)

12. *Water gauges on the Mississippi River and its principal tributaries.*—These gauges were designed to secure information from continuous records, with a view to protecting alluvial lands against overflow, improving navigation, and giving correct reports of the stages of water for the benefit of river men and planters. Their establishment and the maintenance of daily observations were enjoined upon the Secretary of War by joint resolution of Congress approved February 21, 1871 (Stat. L., vol. 16, p. 598). Section 6 of the river and harbor act

of 1888 provided a permanent appropriation for the purpose of securing uninterrupted gauging.

The amount expended to June 30, 1899, was $131,087.88. The 17 gauges ordered by the resolution of February, 1871, were established the latter part of that year, except the one at Carrollton, La., established in January, 1872. Seven additional gauges have been established and three discontinued, and there are now 21 gauges maintained. The service had been improved materially. In 1881 bulletins were erected at the stations on the Mississippi for the purpose of giving passing steamboats the stage of water, and to indicate whether rising, stationary, or falling. In 1890 they were replaced by larger bulletins and the old ones used for extending the service to the tributaries. Since February 1, 1887, the gauges have been read and bulletins posted twice a day. The readings have been published by the Mississippi River Commission to the end of the calendar year 1899.

The yearly expenses of this work, if properly maintained, vary considerably, and extraordinary repairs of the gauges and bulletins, frequent inspections, etc., may increase the cost for one year to double that of the year preceding or following it. At the present time a large number of the gauges need extensive repairs, and the bulletins on the Mississippi, built in 1890, are worn out and should be replaced by a more permanent type. Four new gauges were added in 1890, increasing the cost of observations by the sum of $540 per annum, with additional charges for inspections and repairs.

The laws relating to the water gauges on the Lower Mississippi and its tributaries are as follows:

SEC. 5252. The Secretary of War is hereby authorized and directed to have water-gauges established, and daily observations made of the rise and fall of the Lower Mississippi River and its chief tributaries, at or in the vicinity of Saint Louis, Cairo, Memphis, Helena, Napoleon, Providence, Vicksburgh, Red River Landing, Baton Rouge, and Carrollton, on the Mississippi, between the mouth of the Missouri and the Gulf of Mexico; and at or in the vicinity of Fort Leavenworth, on the Missouri; Rock Island, on the Upper Mississippi; Louisville, on the Ohio; Florence, on the Tennessee; Jacksonport, on the White River; Little Rock, on the Arkansas; and Alexandria, on the Red River; and at such other places as the Secretary of War may deem advisable. The expenditure for the same shall be made from the appropriation for the improvement of rivers and harbors; but the annual cost of the observations shall not exceed the sum of five thousand dollars.

The river and harbor act of August 11, 1888, provided a permanent appropriation for the purpose of securing uninterrupted gauging, as follows:

SEC. 6. That for the purpose of securing the uninterrupted gauging of the waters of the Lower Mississippi River and its tributaries, as provided for in joint resolution of the twenty-first of February, eighteen hundred and seventy-one, upon the application of the Chief of Engineers, the Secretary of War is hereby authorized to draw his warrant or requisition from time to time upon the Secretary of the Treasury for such sums as may be necessary to do such work, not to exceed in the aggregate for each year the amount appropriated in this act for such purpose: *Provided, however,* That an itemized statement of said expenses shall accompany the annual report of the Chief of Engineers.

The amount appropriated in the act of August 11, 1888, was:

For gauging the waters of the Lower Mississippi River and its tributaries as provided for in joint resolution of twenty-first of February, eighteen hundred and seventy-one, nine thousand six hundred dollars: *Provided,* That three thousand six hundred dollars of same is authorized to be expended in paying the expenses of gauging the said waters during the fiscal year ending June thirtieth, eighteen hundred and eighty-eight.

The same act, in the item of appropriation for continuing operations upon the reservoirs at the head waters of the Mississippi River, provided as follows:

> And the Secretary of War shall cause such gaugings to be made at or near St. Paul during the annual operation of said reservoirs as shall determine accurately the discharge at that point, the cost of same to be paid out of the annual appropriation for gauging the waters of the Mississippi River and its tributaries.

Under existing decisions, a fiscal year appropriation of not to exceed $6,000 is provided, of which $500 may be allotted under the law for discharge measurements at St. Paul, Minn. The amount is not sufficient for proper maintenance of the present service.

July 1, 1899, amount allotted for fiscal year ending June 30, 1900	$5,500.00
June 30, 1900, amount expended during fiscal year	5,150.13
July 1, 1900, balance reverting to Treasury	349.87
July 1, 1900, amount allotted for fiscal year ending June 30, 1901	6,000.00

(See Appendix X 11.)

SURVEY OF OUACHITA AND BLACK RIVERS, ARKANSAS AND LOUISIANA, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF AUGUST 18, 1894.

The survey of *Ouachita and Black rivers, Arkansas and Louisiana, with a view to their improvement by locks and dams*, required by the river and harbor act of August 18, 1894, has been made, and preliminary report submitted thereon, by Maj. Thomas L. Casey, Corps of Engineers, February 7, 1900. The plan presented contemplates construction of 13 locks and dams at an estimated cost of $275,000 each or a total cost of $3,575,000 for the entire system. The report was transmitted to Congress and printed in House Doc. No. 480, Fifty-sixth Congress, first session. (See also Appendix X 12.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and survey of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineers and reports thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers:

1. *Preliminary examination of Red River, Texas, from the mouth of the Kiamitia (Kiamichi) River to the mouth of Blue River.*—Maj. J. H. Willard, Corps of Engineers, submitted report March 21, 1899. In his opinion, concurred in by the division engineer, this part of Red River is not worthy of improvement by the General Government at the present time. The report was transmitted to Congress and printed in House Doc. No. 53, Fifty-sixth Congress, first session. (See also Appendix X 13.)

2. *Preliminary examination and survey of Alexandria Harbor, Louisiana.*—Maj. Thomas L. Casey, Corps of Engineers, submitted report February 9, 1900, with plan for improvement at an estimated cost of $11,300, this expenditure being deemed warranted in view of the large property interests at stake. In forwarding the report to this office, the division engineer, for reasons given, stated that in his opinion the proposed improvement should not be undertaken by the General Government. The report was transmitted to Congress and printed in House

Doc. No. 462, Fifty-sixth Congress, first session. (See also Appendix X 14.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Red River, in the States of Louisiana, Arkansas, and Texas, and in Indian Territory from the city of Shreveport, in the State of Louisiana, to the city of Denison, in the State of Texas, with a view to ascertaining whether the navigation of said river can be permanently improved by a system of cut-offs, levees, locks, and dams, or by any other plan.*

2. *The river and harbor front of the city of Camden, Arkansas, on the Ouachita River, with a view to improving said harbor and grading and protecting the river bank in front of said city.*

IMPROVEMENT OF ARKANSAS RIVER AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

This district was in the charge of Capt. Robert McGregor, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Removing obstructions in Arkansas River, Arkansas and Kansas.*—This river was, previous to improvement, seriously obstructed by snags, overhanging timber, reefs, and bars. The banks and bed are very unstable, making frequent contributions of snags and logs, and rendering snagging operations a continuous necessity.

The original project under this head was to raise and destroy snags, cut overhanging timber, remove bowlders and reefs by blasting and dredging, and cut out sand bars by temporary wing dams. To this was later added the survey of the river, with the view to permanent improvement.

Since appropriations for permanent improvement were made, blasting, dredging, and dams have been omitted from the project, leaving customary snagging operations only. The estimated cost is $35,000 annually.

From appropriations for this purpose there had been expended to June 30, 1899, $866,076.38.[1]

The evidence of pilots and masters is that in the permanent reaches of the river the condition has been materially improved; in the shifting channels the relief is only temporary, and the obstructions to navigation are still numerous and dangerous.

Operations during the fiscal year have been confined to keeping open narrow channels through the most obstructed places.

The estimated amount, $35,000 annually, is sufficient to maintain the river free from snags, but owing to lack of funds for the past few years the river is in need of a thorough cleaning out.

From funds allotted to this work one steel snag boat is being constructed to replace the *Wichita*, which was worn out; and it is proposed to make available a second and larger boat for the lower river by repairs to the snag boat *C. B. Reese*, which has been out of commission since 1893.

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[1] In addition to this there had been applied to this work $26,272, allotted from appropriation for improving Arkansas River.

The commerce of the stream consists of plantation products and supplies, timber and cooper stuffs, and general merchandise. Tabulation showing yearly tonnage and values is given under the heading "Improving Arkansas River, Arkansas."

July 1, 1899, balance unexpended	$23,207.08
June 30, 1900, amount expended during fiscal year	8,796.42
July 1, 1900, balance unexpended	14,410.66
July 1, 1900, outstanding liabilities	500.00
July 1, 1900, balance available	13,910.66
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix Y 1.)

2. *Arkansas River, Arkansas.*—The channel of this river, in addition to being badly obstructed with snags, was for nearly all of its length of an unstable character, obstructed by shifting sand bars and, in the upper reaches, by gravel bars and some reefs of rock. Prior to 1886, works upon the river were for improvement of special detached reaches, generally with immediate reference to confining the channel to the drawspans of bridges and the water fronts of towns, or to the improvement of some especially difficult crossing. The availability of the channel for navigation depended entirely on the stage of water, navigation of every sort being practically abandoned during seasons of extreme low water.

The act of August 11, 1888, adopted a project for the improvement of the river from Wichita, Kans., to the confluence of its navigable mouth with the Mississippi, based on plans and estimates covering only a portion of this distance. The plans approved were for two detached reaches; that from Arkansas City, Kans., to Fort Gibson, Ind. T.,[1] and that from Little Rock, Ark., to the mouth,[2] a total distance of 417 miles, at an estimated cost of $4,378,544. The improvement authorized covers 771 miles. Furthermore, after a lapse of twelve years, the total of appropriations available for the project has been less than $1,000,000, a large part of which has necessarily gone for maintenance of works built in isolated spots and for carrying over a large plant from one appropriation to another. In view of the above the cost of the project has been given as indefinite.

The approved project may therefore be stated as follows: To remove rock and gravel reefs by blasting and dredging, to contract the channel by dikes or dams, permeable or solid, of such construction as the local conditions require, and to hold the channel so obtained by revetment where necessary; the project to include the river from Wichita, Kans., to the mouth, a distance of 771 miles.

From the appropriations made for the improvement of this river there had been expended to June 30, 1899, $1,135,630.26. Of this, $26,272 was expended, under allotments, for removing snags, etc., from the channel, leaving $1,109,358.26 expended on improvements proper. Of this latter amount, $159,500 was for special projects, and $949,858.26 was applied to the present approved project.

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[1] Printed in House Ex. Doc. No. 90, Forty-ninth Congress, first session.
[2] See Annual Report of the Chief of Engineers for 1885, page 1601.

The special work, and some of that done on the project before July 1, 1894, was for local improvements, such as the construction of dikes at Dardanelle to remove a bar from the front of the town; the construction of revetments and dikes to stop caving along the town front of Pine Bluff; the construction of dikes to maintain the channel through the drawspans of bridges at Fort Smith, Vanburen, Little Rock, and Robroy, and the construction of dikes at a few of the troublesome crossings. Since July 1, 1894, the work on the project has been that of repairing the works previously built, and making the improvement continuous from Little Rock to a point 20 miles above. To June 30, 1899, the channel had been maintained through the drawspans of all bridges crossing the river, caving of banks had been stopped along the town front of Pine Bluff, and to a great measure in the 20-mile reach above Little Rock. At crossings where the work remained intact through the flood of May, 1898, indications of material improvement were shown.

Operations during the past fiscal year were confined to repairs to works already constructed, which suffered during the flood of May, 1898. Of the amount appropriated by act of March 3, 1899, $40,000 was allotted for removing obstructions, etc., and applied to necessary repairs and additions to plant under that head.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1895	$2,380,420	50,498	1898	$1,626,756	58,578
1896	2,408,720	54,261	1899	2,470,131	68,057
1897	1,657,218	66,077	1900	2,078,940	75,654

Within the last year two transportation lines have been organized for the purpose of operating on this river, one to run a steamer between Pine Bluff and New Orleans, the other to run a steamer out of Pine Bluff to Wildcat and to Red Fork. One company that operated a steamer between Little Rock and Dardanelle has withdrawn from the river.

July 1, 1899, balance unexpended		$97,869.74
June 30, 1900, amount expended during fiscal year:		
Removing obstructions, etc	$11,642.20	
On project	47,615.29	
		59,257.49
July 1, 1900, balance unexpended		[1]38,612.25
July 1, 1900, outstanding liabilities	$1,000.00	
July 1, 1900, amount covered by uncompleted contracts	23,029.30	
		24,029.30
July 1, 1900, balance available		14,582.95
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix Y 2.)

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[1] $27,085.80 for removing obstructions, etc.; $11,526.45 for project.

3. *White River, Arkansas.*—In its original condition this river was much choked with drift piles, logs, and snags, and in its upper reaches by bowlders and gravel shoals. The earlier projects were mainly for snagging, with the addition later of projects for removing rocks and bowlders. At the time of adopting the project for permanent improvement, in 1888, the river from Newport to the mouth was reasonably free from snags, and the controlling depth on shoals was said to be about 3 feet at ordinary low water. Above Newport the river was still much obstructed by timber, and from Batesville up there were numerous bad shoals, rendering navigation very uncertain.

The project of 1888 (Annual Report of the Chief of Engineers for 1888, p. 1406) contemplated the deepening of the water on shoals by contracting the channel, and the removal of rock and bowlders in the upper river by blasting, the object being to obtain a channel 5 feet in depth at low water from the mouth to Newport, and 2 feet in depth from Newport to Forsyth, Mo., at an estimated cost of $105,815. It also included an additional estimate of $8,000 per year for two or three years for snagging. For reasons given in the Annual Report of the Chief of Engineers for 1891, page 2049, the estimates were inadequate to accomplish the object. The act of July 13, 1892, appropriated $53,815 to complete the project and an additional sum of $21,185 to be expended "in the discretion of the Secretary of War." These funds, and those appropriated since that date, have been applied to snagging and to continuing the improvement of the river above Newport on the lines of the project of 1888, with the addition of dredging on shoals.

Up to June 30, 1899, there had been expended on this river $366,801.57. Of this amount $166,000 was on projects previous to 1888, and $108,815 was under the project of 1888, including snagging, and $91,986.57 was for continuing the improvement under discretionary application by the Secretary of War. Of this latter amount, $4,000 has been allotted to Cache River, $11,061.46 expended for special works at Batesville, and the balance, $76,925.11, for snagging and for maintaining the works above Newport.

The results obtained under the project of 1888 in the lower river have not been permanent. Snagging has given much relief to navigation, and has made available such channel as existed. During the year ending June 30, 1899, the average channel depth on shoals in the lower river was 3 feet, with a least depth of 30 inches at Little Island. In the upper river such channel as was obtained was impracticable for navigation owing to swift water on the shoals, and provision has been made for the river from Batesville up by a separate project for locks and dams, a report of which will be found under "Upper White River."

Operations during this fiscal year have been confined to snagging from Newport to Wolf Bayou, 12 miles above Batesville. The river below Newport is in need of attention, but the balance of the funds on hand will be needed for extensive repairs to plant.

For maintenance of the channel from Batesville to the mouth there will be needed the sum of $12,000 annually. By a contemplated rearrangement of plant it is expected to give this river better service in the matter of snagging. In addition to this there will be required, for the present at least, annual dredging between Newport and Batesville.

Both of these items are included in the estimate above for annual maintenance.

Condensed commercial statistics, year ending May 31.

Year.	Tons.	Value.	Year.	Tons.	Value.
1895	73,759	$2,494,377	1898	102,337	$1,415,013
1896	74,882	2,056,991	1899	117,891	1,619,351
1897	73,962	2,435,814	1900	127,906	2,228,007

No new lines of transportation have been established during the year.

July 1, 1899, balance unexpended	$18,013.43
June 30, 1900, amount expended during fiscal year	3,817.16
July 1, 1900, balance unexpended	14,196.27
July 1, 1900, outstanding liabilities	101.25
July 1, 1900, balance available	14,095.02
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenace of improvement, in addition to the balance available July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix Y 3.)

4. Upper White River, Arkansas.—The original condition of this portion of White River and the previous projects for its improvement are given in the report for White River.

The approved project for this work, based on a report printed in the Annual Report of the Chief of Engineers for 1897, page 1992, contemplates providing slack-water navigation from Batesville to Buffalo Shoals, a distance of 89 miles, by means of 10 fixed dams with concrete locks. The locks are to be 175 feet long between hollow quoins and 36 feet wide, with a lift of about 14 feet, and with a depth of 4 feet on the lower miter sills.

The total estimated cost is $1,600,000, based on having sufficient funds on hand to construct one lock and dam complete each working season.

Up to June 30, 1899, there had been expended on this work $535.79. Plans were in preparation for the first lock, and the survey of pool No. 1 was nearly completed.

During the year ending June 30, 1900, the survey of pool No. 1 was completed, and the exact locations of Dams Nos. 1 and 2 determined. Plans have been completed for the locks and dams at sites Nos. 1 and 2. Owing to delay in procuring land at the site of Lock No. 1, below Batesville, construction could not be begun last season. The land was procured in December, 1899, and the plant has been installed, and work upon the cofferdam for Lock No. 1 is well under way.

COMMERCIAL STATISTICS.

Only one steamboat reports navigating this stream during the last year. The bulk of the commerce reported was rafted.

Value and tonnage.

	Tons.	Value.
Year ending May 31:		
1899	9,059	$548,335
1900	39,253	1,260,712

July 1, 1899, balance unexpended	$159,464.21
Amount appropriated by sundry civil act approved June 6, 1900	150,000.00
	309,464.21
June 30, 1900, amount expended during fiscal year (Lock and Dam No. 1)	22,159.28
July 1, 1900, balance unexpended	[1] 287,304.93
July 1, 1900, outstanding liabilities	4,500.00
July 1, 1900, balance available	282,804.93
Amount (estimated) required for completion of existing project	1,290,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Y 4.)

5. *Buffalo Fork of White River, Arkansas.*—This stream in its original condition was obstructed by overhanging timber and by bowlders and rocks projecting above the bed of the shoals. The slope is steep and the bends in the channel very abrupt. Navigation is carried on by flatboats and rafts at medium stages of water. The low-water depth on shoals is about 5 inches.

The act of March 3, 1899, appropriated $3,500 for improving Buffalo Fork, based on a report of a survey made to comply with the provisions of the river and harbor act of June 3, 1896, published in the Annual Report of the Chief of Engineers for 1897, page 1994. The work proposed was to cut the overhanging timber and remove from the shoals the loose and solid rock that projected above the general plane of the bed of the shoals from the mouth to Rush Creek, 24½ miles.

A party began work September 1, 1899, at Rush Creek, the upper limit of the proposed work. The work was completed November 6, 1899, making the natural channel available to the fullest extent for flatboats and rafts.

The commerce of Buffalo Fork was made up of rafted ties and cedar. For the year ending May 31, 1900, the total commerce was 998 tons, valued at $8,436.

July 1, 1899, balance unexpended	$3,500.00
June 30, 1900, amount expended during fiscal year	3,043.06
July 1, 1900, balance unexpended	456.94
July 1, 1900, outstanding liabilities	3.75
July 1, 1900, balance available	453.19

(See Appendix Y 5.)

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[1] $137,304.93 for Lock and Dam No. 1; $150,000 toward Lock and Dam No. 2.

6. *Cache River, Arkansas.*—In its original condition this stream was much obstructed by snags, drift, and overhanging timber.

The channel of the river is well-defined, with a low-water depth on the controlling shoals of 6 to 8 inches.

The projects adopted for this river have all been for keeping the river clear of snags and drift.

The amounts expended on this work to June 30, 1899, from direct appropriations, was $9,000, and from allotments from appropriations for White River, Arkansas, by acts of 1894 and 1896, $4,000, making a total of $13,000.

The operations of snag boats have rendered navigation practicable as far up as James Ferry, about 72 miles from the mouth, for small boats used in bringing out rafts at high stages.

Operations during the fiscal year ending June 30, 1900, have consisted of snagging and cutting overhanging timber, making a fair fting channel from Maberry Ferry to Choctaw and Memphis Bridge (42 miles).

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1895	$25,494	12,603	1898	$36,635	10,193
1896	62,483	20,748	1899	52,936	7,667
1897	108,460	34,990	1900	29,961	11,215

The commerce of this stream is made up of timber, and the bulk of it is rafted. Two small steamboats were operated when there was sufficient water.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	952.85
July 1, 1900, balance unexpended	47.15
July 1, 1900, outstanding liabilities	47.15
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix Y 6.)

7. *Black River, Arkansas and Missouri.*—In its original condition this river had a controlling depth on shoals of 2 to 2½ feet at low water. The river, especially that portion above the mouth of Current River, was almost impassable at low stages on account of snags, drift, and overhanging timber. Pocahontas was considered the head of navigation, and rafting was impossible above the Arkansas and Missouri State line.

The first project for the improvement of this river, submitted in 1880 (Annual Report of the Chief of Engineers for 1880, p. 1326), contemplated removing snags, logs, etc., cutting down shoals by means of wing dams and closing some of the most troublesome sloughs. The estimated cost was $80,800. Sufficient funds were never appropriated to complete the project, and appropriations since 1884 have averaged less than half that estimated ($8,000) for annual maintenance.

The total amount expended to June 30, 1899, was $102,391.91.

Material improvement in the condition of this stream is shown. The controlling channel depth at low water at the above date was 3 feet to mouth of Current River. Above that point the river has not been worked sufficiently to produce permanent results.

Operations during the year were confined to snagging—clearing a channel over such portions of the river as carry the heaviest commerce.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1895	$1,085,415	132,433	1898	$788,640	115,612
1896	891,437	111,278	1899	529,336	83,404
1897	1,704,799	111,611	1900	966,961	129,698

Timber, lumber, plantation products, and supplies make up the commerce of this stream. The tonnage is about equally divided between rafts and steamboats.

July 1, 1899, balance unexpended	$8,101.09
June 30, 1900, amount expended during fiscal year	6,056.65
July 1, 1900, balance unexpended	2,051.44
July 1, 1900, outstanding liabilities	160.00
July 1, 1900, balance available	1,891.44
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix Y 7.)

8. *Current River, Arkansas and Missouri.*—The original condition of this stream was such that no steamboat navigation above the mouth of Little Black River was attempted except when the river was at high stages. Below Little Black River navigation was suspended when the the river was below medium stage. The natural depths were not available on account of snags and leaning timber. For a résumé of work done prior to 1894 see the Annual Report of the Chief of Engineers for 1896, page 1689.

The project of December 11, 1890 (Annual Report of the Chief of Engineers for 1891, p. 2065), provided for improving the channel to Vanburen, Mo. (95 miles), by the usual snagging operations, and by contracting the channel at the worst shoals by wing dams. The appropriation of June 3, 1896, completed the amount estimated for this project. The last appropriation, March 3, 1899, was made for continuing the work and for maintenance.

The amount expended to June 30, 1899, was $16,927.05. Under the project of 1890 all the funds appropriated were confined to snagging, the highest point reached being 31 miles below Vanburen. At the close of the fiscal year 1899, no work having been done since 1897, the river was not in good condition.

Operations during the fiscal year ending June 30, 1900, consisted in snagging from the mouth to Little Black River, 32 miles, where the work was very heavy.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1895	$362,447	31,205	1898	$306,216	52,417
1896	227,291	29,867	1899	239,869	43,050
1897	581,528	17,078	1900	578,834	65,043

Rafted saw logs and railroad ties make up the bulk of the commerce for this stream.

July 1, 1899, balance unexpended	$5,072.95
June 30, 1900, amount expended during fiscal year	3,670.24
July 1, 1900, balance unexpended	1,402.71
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix Y 8.)

9. *St. Francis River, Arkansas.*—In its original condition this stream was not navigable at any stage above Lester Landing, between Lester Landing and Marked Tree navigation was possible at high stages only, and below Marked Tree it was difficult at medium stages. Snags and fallen timber were the principal obstructions.

The original project was to improve navigation below Lester Landing by cutting a channel through "The Lake" and clearing the river of obstructions by snagging operations. The present project (adopted October 21, 1884), is to remove drift, logs, and snags from the channel and overhanging timber from the banks from the mouth to Kennett, Mo. (279 miles), and close chutes and sloughs in "The Sunk Lands," so as to make the river navigable at high stages to Kennett, Mo., at medium stages to Marked Tree, and at low stages to a point about 30 miles below Madison, Ark.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $58,908.65.

The condition of the river below Marked Tree on June 30, 1899, was good for navigation at a 4-foot stage or over. Above Marked Tree a fair high-water channel had been made through the "Sunk Land."

Operations during the year ending June 30, 1900, consisted of cutting overhanging timber and removing snags from the mouth to 15 miles above Madison, or 85 miles above the mouth. This part of the river was left in good condition.

Commercial statistics, year ending May 31.

Year.	Tons.	Value.	Year.	Tons.	Value.
1895	38,107	$321,439	1898	23,819	$237,481
1896	67,740	401,457	1899	27,892	315,459
1897	97,348	1,117,891	1900	45,056	194,057

Rafted saw logs make up about four-fifths of the commerce reported. The rest of the commerce is made up of plantation products. Rough lumber and staves are handled by steamboats that ply this stream whenever there is sufficient water.

July 1, 1899, balance unexpended	$8,091.35
June 30, 1900, amount expended during fiscal year	5,335.48
July 1, 1900, balance unexpended	2,755.87
July 1, 1900, outstanding liabilities	80.00
July 1, 1900, balance available	2,675.87
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix Y 9.)

10. Removing sunken vessels or craft obstructing or endangering navigation.—On July 3, 1899, it was reported that the navigation of Black River, Arkansas, was obstructed by the wreck of the steamer *W. J. Bryan*, which sunk August 20, 1898, 4 miles above Elgin, Ark. On July 19 the sum of $150 was allotted for its removal. Work was begun August 4. The wreck was broken up and cleared away about 10 feet below low water over that portion lying in the channel.

December 8, 1899, the machinery recovered from the wreck was turned over to the owner, Mr. G. W. Schwartz, by authority of the Secretary of War, Mr. Schwartz having reimbursed the Government for the cost of removal.

On July 2, 1899, a stone barge was wrecked in Little Red River near Judsonia, Ark. This wreck was reported August 18, 1899, and on September 16, 1899, the sum of $250 was allotted for its removal. The work was completed October 12, 1899, at a cost of $183.13.

(See Appendix Y 10.)

EXAMINATIONS AND SURVEY REQUIRED BY THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. Robert McGregor, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers:

1. Preliminary examination of Current River, Missouri, with a view to the improvement of said river between the junction of Crooked Creek and Current Creek with the Current River in the northwest corner of Shannon County and the southern line of Carter County.—Captain McGregor submitted report August 29, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 65, Fifty-sixth Congress, first session. (See also Appendix Y 11.)

2. Preliminary examination of St. Francois (St. Francis) River, Missouri.—Captain McGregor submitted report April 28, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 41, Fifty-sixth Congress, first session. (See also Appendix Y 12.)

Arkansas River, Arkansas and Indian Territory.—A Board of Engineers, appointed under the requirements of the river and harbor act of March 3, 1899, to make an examination and survey of the Arkansas River, and to report such plan for the permanent improvement of said river as, in its opinion, is most feasible and best adapted to the necessities of commerce, has had the subject under consideration, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE OHIO AND MISSOURI RIVERS, OF HARBOR AT ST. LOUIS, MO., AND TO PREVENT THE MISSISSIPPI RIVER FROM BREAKING THROUGH INTO CACHE RIVER AT BEECHRIDGE, ABOVE CAIRO, ILL.

This district was in the charge of Capt. Edward Burr, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Removing snags and wrecks from the Mississippi River below the mouth of the Missouri River.—Before this work was inaugurated, and for many years afterwards, the navigation of the river was very much interfered with by numerous snags, logs, etc., which had lodged in the channel, and to which new additions were made with each rise in the river. A large number of wrecked flatboats, barges, steamboats, and all manner of river craft are found in the navigable channels, and menace life and property.

For the removal of these obstructions appropriations were made as early as 1824. The project adopted consisted of building boats suitable for removing the snags, logs, rack heaps, etc., and operating them whenever the stage of water was favorable and funds were available.

The amount expended upon this work on the reach of the river below the mouth of the Missouri prior to 1879 can not now be definitely ascertained, for the reason that during much of the time appropriations were made at irregular intervals in lump sums, to be applied to several streams as their needs or the terms of the law might require. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1899, there had been expended $1,460,769.25. This expenditure made great improvement in the navigation of the river and lessened the danger to boats. During the fiscal year ending June 30, 1900, the sum of $86,355.29 has been expended.

Two steel snag boats were employed in removing the obstructions to navigation between the mouth of the Missouri River and New Orleans, and during the year removed 4,479 snags and 19 drift piles. Fifteen thousand one hundred and seventy trees were felled and 22,630 miles were run.

An annual appropriation, not to exceed $100,000, for carrying on this work was made by the act of August 11, 1888. Under this appropriation the two snag boats will patrol the river and remove obstructions where necessary.

For recapitulation of commercial statistics reference should be made to report upon improving Mississippi River between Ohio and Missouri rivers.

Amount drawn under section 7, act of August 11, 1888	$86,355.29
June 30, 1900, amount expended during fiscal year	86,355.29
July 1, 1900, amount available for fiscal year 1900–1901	100,000.00

(See Appendix Z 1.)

2. *Mississippi River, between Ohio and Missouri rivers.*—The original condition of the navigable channel of this portion of the Mississippi River before the work of improvement was begun was such that the natural depth at low water was in many places from 3½ to 4 feet. The channels were divided by islands, which formed sloughs and secondary channels, through which a great deal of the volume of the flow was diverted, to the detriment of navigation.

The first work for improvement began in 1872, and was continued for a number of years as appropriations were made, the works, consisting of dikes and dams of brush and stone, erected with a view to confining the low-water volume to a single channel, and of revetments, to hold and preserve the banks where necessary or advisable to do so.

The present project is a continuation of the plan adopted in 1881. It also contemplates confining the volume of the river at low water to a single channel, its approximate width to be, below St. Louis, about 2,500 feet, the natural width being in many cases from 1 to 1½ miles. The method principally employed is the closing of sloughs and secondary channels and building up of new banks out to the line desired, using the solid matter brought down by the river, and which is collected by means of hurdleworks. The banks, both new and old, are revetted where necessary.

The object of the improvement is to obtain eventually a minimum depth, at standard low water, of 6 feet from the mouth of the Missouri to St. Louis, and of 8 feet from St. Louis to the mouth of the Ohio.

The original estimate of the cost of the improvement, as revised in 1883, is $16,397,500.

The total amount expended to June 30, 1899, was $8,613,869.06, exclusive of $180,000 allotted by acts to projects for improvement between the Illinois and the Missouri rivers, including Alton Harbor.

The amount expended during the fiscal year ending June 30, 1900, includes $62,317.64 expended during the year for dredge plant, portable jetties, and for operating the same. The total amount thus far expended for what is termed temporary channel improvements is $533,489.53, much of which has been for plant that is now on hand and available for future work. The approximate value of this plant is $232,846.24.

The result of the expenditure of this amount has been the partial improvement of the whole reach of the river from St. Louis to Cairo. During last year there was at all times throughout this reach a navigable channel 5 feet or more in depth and, excepting for a few days, of 6 feet or more, the river reaching a low-water stage of −2.52 feet below standard low water.

The work done during the last year in the line of permanent improvement consisted in repairs to existing contraction works and revetments and a further extension of the same in localities where work had been commenced, in addition to new works in localities where no work had heretofore been done.

For the permanent improvement of the river, new works were constructed at the mouth of the Missouri River, for the protection of the Illinois bank, under special statute allotment of $100,000; at Lucas, for the further contraction of the river, to improve shoal crossings; at Danby Landing, in extending the existing revetment upstream; at Horse Island, opposite Chester, in raising the existing revetment to higher levels, and at Devils Island in extending the existing revetment and raising it to higher levels.

Repairs were made to existing works at Twin Hollows, Chesley Island, Calico Island, Michaels Landing, Osborne Field, Danby Landing, Ste. Genevieve, Kaskaskia Island, Liberty, Hamburg Island, and Devils Island.

Work for the temporary improvement of the low-water channel by means of portable jetties and dredging appliances was carried on at Sulphur Springs, Turkey Island, Ste. Genevieve Bend, and at the entrance to the winter harbor in Old River. By means of these temporary expedients a gain of from 6 inches to 3 feet in channel depth was effected at these points. But one portable jetty was constructed. It was placed at Turkey Island middle crossing, and was 1,200 feet long.

With the present appliances, and such others as may be developed for the temporary improvement of low-water channels, it is expected that a navigable depth of at least 6 feet will be maintained between St. Louis and Cairo during all low-water stages that the river is open to navigation, and until the projected depth is obtained throughout by the extension and completion of the works for the permanent improvement. There can be no doubt of the ultimate success of this permanent improvement and of its value to the commercial interests involved.

To prevent the suspension of this important work for lack of funds, the river and harbor act of June 3, 1896, made provision for three years' work from July 1, 1897, to be paid for as appropriations should be made by law, at the rate of $673,333.33 annually. The last of these annual appropriations was provided by the act of March 3, 1899, and was practically exhausted by June 30, 1900. By suspending all operations during the last half of this fiscal year sufficient funds were reserved to provide for emergencies and for urgent low-water operations during the present season. To the amount thus reserved $100,000 was added by allotment from the act of June 6, 1900, but the total of funds available is sufficient only for two months' work with a partial force, and for the care of the large plant of the work until such time as further appropriations may be expected. The loss to the Government and to the commerce of the Mississippi River by the interruption of work for this important improvement can not be even approximately stated. The improvement not only makes no progress, but actually retrogrades, and navigation interests are decreasing from failure to obtain and maintain such channels as are necessary for economical transportation. It seems now certain that the procuring of satisfactory channels at all seasons of open navigation is merely a matter of providing funds in sufficient quantities to do the work economically. The local officer states that $150,000 is required annually for temporary low-water operations alone.

The sundry civil act approved March 3, 1899, requires that from the appropriation made by that act for improving the Mississippi River from the mouth of the Ohio River to the mouth of the Missouri River the sum of $10,000 "shall be expended for the protection of the bank on the Missouri side and to deepen and to straighten the channel at Wittenberg, in Perry County, in the State of Missouri." Captain Burr, the local officer, reports that a careful examination and survey of the locality in which the work is proposed to be done under this allotment of $10,000 have been made and fail to show that any work is necessary for the protection of the bank on the Missouri side or for straightening the channel at any point in the neighborhood of Wittenberg; the Missouri bank requires no attention, and the channel is in a good and satisfactory condition. I recommend, therefore, that the provision requiring the expenditure of funds at this locality be repealed, and that authority be given for use of the amount on the general work for improvement of the Mississippi River between the mouth of the Ohio and the mouth of the Missouri.

Recapitulation of commercial statistics.

	1896.	1897.	1898.	1899.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Receipts and shipments at St. Louis	1,244,175	1,046,035	906,168	669,815
Transferred by ferries at St. Louis	2,529,786	3,042,674	4,033,871	5,036,730
Shipped from landings between St. Louis and Cairo	75,513	69,815	53,785	30,716
Total	3,849,474	4,158,524	4,993,824	5,737,261

July 1, 1899, balance unexpended		$911,130.92
September 11, 1899, transferred from appropriation for preventing break in Mississippi River at Beechridge, Ill		9,587.48
March 17, 1900, transferred from appropriation for preventing break in Mississippi River at Beechridge, Ill		12,714.84
January 17, 1900, redeposited by Maj. Thos. H. Handbury, Corps of Engineers, to credit of appropriation		5.84
Allotted from appropriation in sundry civil act approved June 6, 1900		100,000.00
		1,033,439.08
June 30, 1900, amount expended during fiscal year		541,560.84
July 1, 1900, balance unexpended		491,878.24
July 1, 1900, outstanding liabilities	$7,457.43	
July 1, 1900, amount covered by uncompleted contracts	42,841.01	
		50,298.44
July 1, 1900, balance available		[1] 441,579.80
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		750,000.00

(See Appendix Z 2.)

3. *Harbor at St. Louis, Mo.*—St. Louis Harbor is about 18 miles long and divided into two nearly equal parts by the Eads Bridge. The upper part, included between the bridge and the northern limits of the city, is about 10 miles in length.

Three miles above the Eads Bridge is the Merchants Bridge. The lower part of the harbor, included between Eads Bridge and the River

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[1] Of this balance special allotments have been made by Congress, as follows:

Bank protection at Cairo, Ill., act of July 5, 1884 (balance)	$7,400.00
Bank protection on east side of Mississippi River, opposite mouth of Missouri River, acts of June 3, 1896, and March 3, 1899	52,487.76
	59,887.76

Des Peres, is 8 miles long. The channel in this part of the harbor has sufficient depth and accessible landings at all points. Good depth exists above the Merchants Bridge.

Congress, by act approved September 19, 1890, appropriated $182,000 for improvement of this harbor.

The navigable reach between the Eads Bridge and Merchants Bridge was at that time obstructed by a number of middle bars. The project adopted for improvement of the harbor under the appropriation of 1890 consisted in a contraction of the waterway between those bridges to a width of about 2,000 feet, in order to concentrate the flow upon the bars, and thus cause scour to the depth desired. The contraction works consisted of a series of hurdles extending out from the Illinois shore, the object of the hurdles being to collect deposits of material brought down during floods, and thus build up a new bank out to the line desired.

This work, which was accomplished by the close of the fiscal year ending June 30, 1892, caused extensive deposits of sediment along the line of hurdles, and has resulted in considerable increase in channel depth, with corresponding benefit to navigation.

Amount expended to July 1, 1899, $150,762.03. There was no expenditure during the past fiscal year.

The full amount of the estimate for the improvement of this part of the harbor has been appropriated. With the balance remaining it is proposed to repair damage that may occur to the hurdles from ice and drift and to extend them wherever found necessary to do so.

For recapitulation of commercial statistics reference should be made to report upon improvement of Mississippi River between Ohio and Missouri rivers.

July 1, 1899, balance unexpended	$31,237.97
July 1, 1900, balance unexpended	31,237.97

(See Appendix Z 3.)

4. *To prevent the Mississippi River from breaking through into the Cache River at or near a point known as Beechridge, a few miles above Cairo, Ill.*—The sundry civil act approved June 4, 1897, contains an item providing for this work which reads as follows:

> For the purpose of preventing the Mississippi River from breaking through into the Cache River at or near a point known as Beach Ridge [Beechridge], a few miles north of Cairo, whereby the National Cemetery at Mound City, at the mouth of the Cache River, and the marine hospital at Cairo would be in imminent danger of destruction, the sum of one hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated, to be immediately available.

The project for this work not being based upon a survey under the Engineer Department and the extent of the work contemplated not being known, an estimate of its total cost could not be given. From a study of the conditions involved, it would seem that the object of the appropriation could best be carried out by revetting as great a length of the bank of the Mississippi River in the vicinity of Beechridge Railroad Station as the funds will suffice.

The project for the expenditure of the amount appropriated contemplates commencing at a suitable point on the bank of the river a short distance above the nearest point to Beechridge Station, building a short hurdle out into the stream to protect the head of the revetment, and then revetting the bank in the usual manner down as far as the funds will suffice.

Under this project during the previous fiscal years a hurdle 275 feet in length was constructed, and 9,435 linear feet of low-water revetment was put in place, 4,700 linear feet of bank being protected to a 30-foot stage, and 4,735 feet to stages varying from 30 to 14 feet. The low-water revetment was about 130 feet in width, extending from the low-water line out into the river. Four hundred and forty feet of the upper portion of this was made of brush and the remainder of lumber about 1 inch thick, from 4 to 6 inches wide, and 12 feet in length. This was woven in and out similar in manner to using the brush. After the high water had graded the bank back, the upper revetment of stone was put on.

During the past fiscal year the revetment was raised to the 33-foot stage from the upper end downstream for 5,000 feet and to the 25-foot stage for the remainder of its length. Repairs were made to the work done in previous years. The amount expended to June 30, 1899, was $64,756.80.

The work is being done by purchase of material in open market and hired labor, using Government plant belonging to the general improvement of the river between the mouth of the Missouri and the mouth of the Ohio River.

The funds available will be sufficient to complete, including work already done, about 10,000 feet of revetment to a height about the 30-foot stage.

In accordance with the requirements of the river and harbor act of March 3, 1899, an examination and survey of the Mississippi River have been made at and near Beechridge "with a view to ascertain whether there is danger of said river breaking through into Cache River, and whether it is desirable to make further specific appropriations to protect the bank of the Mississippi River at said place; and if so, the cost thereof." A report thereon, with an estimate of cost, was transmitted to Congress at its last session and printed in House Doc. No. 90, Fifty-sixth Congress, first session; it is also submitted as Appendix Z 6 of this report.

For recapitulation of commercial statistics reference should be made to report upon improvement of Mississippi River between Ohio and Missouri rivers.

July 1, 1899, balance unexpended		$35,243.20
June 30, 1900, amount expended during fiscal year		27,458.23
July 1, 1900, balance unexpended		7,784.97
July 1, 1900, outstanding liabilities	$5.75	
July 1, 1900, amount covered by uncompleted contracts	83.20	
		88.95
July 1, 1900, balance available		7,696.02

(See Appendix Z 4.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. Edward Burr, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers:

1. *Preliminary examination and survey of Mississippi River at or near Wagners Landing, below Rockwood, Ill.*—Captain Burr submitted

reports dated May 2 and October 4, 1899, respectively, with plan for improvement at an estimated cost of $174,000. This locality is included in the general project for improvement of the river, and Captain Burr does not recommend specific appropriation for the work, as it can be provided for systematically and with more promptness and certainty with adequate appropriations for the general improvement of the river. His views are concurred in by the division engineer and by me. The reports were transmitted to Congress and printed in House Doc. No. 85, Fifty-sixth Congress, first session. (See also Appendix Z 5.)

2. *Preliminary examination and survey of Mississippi River at or near Beechridge, Ill.*—Captain Burr submitted reports dated May 2 and September 1, 1899, respectively, with plan for improvement at an estimated cost of $216,000. The conclusions reached by him as the result of the survey are fully set forth in his report, and are concurred in by the division engineer and by me. The reports were transmitted to Congress and printed in House Doc. No. 90, Fifty-sixth Congress, first session. (See also Appendix Z 6.)

EXAMINATION OF THE HARBOR OF HARRISONVILLE, ILL., REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of the *harbor of Harrisonville, Ill., in the Mississippi River, with a view to restoring it*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

OPERATING SNAG BOATS AND DREDGE BOATS ON UPPER MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN MOUTH OF MISSOURI RIVER AND ST. PAUL, MINN., AND OF LA CROSSE HARBOR, WISCONSIN; OPERATING AND CARE OF GALENA RIVER IMPROVEMENT, ILLINOIS.

This district was in the charge of Maj. C. McD. Townsend, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. *Operating snag boats and dredge boats on Upper Mississippi River.*—By the river and harbor act of August 11, 1888, provision was made for operating snag boats and dredge boats on the Upper Mississippi River under a permanent appropriation, the sum so expended not to exceed $25,000 annually.

From July 7 to November 1, 1899, and from May 14 to June 30, 1900, the snag boat *General Barnard* was employed removing snags and similar obstructions and otherwise assisting interests of navigation between Minneapolis and the mouth of Missouri River. Dredge *Ajax* and steam-drill boat 103 removed 4,730 solid cubic yards of rock from the channel near mouth of Rock River.

The total amount expended for snag-boat service to June 30, 1899, was $799,640.

The total amount of freight transported on the Upper Mississippi River during the calendar year 1899 was about 2,900,000 tons, and the ton miles, 641,348,000.

The amount expended during the fiscal year ending June 30, 1900, was $24,944.

(See Appendix A A 1.)

2. *Mississippi River between Missouri River and St. Paul, Minn.*—Under this head is carried on the improvement of through navigation and also such special harbor or levee work as is provided for by Congress. Systematic work was begun in 1878, and such good results have been secured as to demonstrate that with a continuance of operations under liberal appropriations the low-water channel of the Mississippi River between St. Paul and the Missouri River can be made sufficiently deep, available, and permanent to satisfy the demands of commerce.

The navigation interests are very large and important. The amount of freight carried during season of 1899, including logs and lumber, was approximately 2,900,000 tons, and the ton miles, 641,348,000.

The original condition of the channel between the Missouri River and St. Paul was such that in low stages the larger boats were unable to proceed farther up the river than La Crosse or Winona, and in many seasons at points much lower down their progress was checked or seriously hindered.

The originally adopted project for the improvement, which has not been materially changed, proposed the contraction of the channel or waterway by means of wing and closing dams to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width and of a depth of 4.5 feet at low water to be eventually increased to 6 feet by further contraction.

There was expended on the improvement to June 30, 1899, the sum of $8,757,192.88. At that date, and for several years previous, the condition of the channel was such as to permit the passage of the largest river boats at very low stages through to St. Paul.

During the past year work has been carried on by hired labor and use of Government plant between St. Paul and Cassville, at Rock Island Rapids, between Montrose and Nashville, Quincy and mouth of the Missouri River, and under formal contract between Reeds Landing and La Crosse, Lansing and Le Claire, Rock Island and Montrose, Keokuk and Quincy, Hamburg and the Missouri River. At all localities where work was performed good results were obtained. Under various special allotments made by Congress operations were carried on at La Crosse Harbor, Clinton, Flint Creek to Iowa River Levee, Warsaw to Quincy Levee, Sny Island Levee, Quincy Bay, and bar at Quincy.

There was expended for channel improvement during the year about $663,000, and an increased depth was obtained at many localities, never less than 1 foot and generally more. The maximum draft that could be carried June 30, 1900, at extreme low water was, as nearly as can be ascertained, from the Missouri River to foot of Des Moines Rapids, 4 feet; on the Des Moines Rapids, 5 feet; from head of Des Moines Rapids to foot of Rock Island Rapids, 3.5 feet; on Rock Island Rapids, 4 feet; from head of Rock Island Rapids to mouth of St. Croix River, 3.5 feet; from the St. Croix River to St. Paul, 4.5 feet.

As regards the Flint Creek to Iowa River Levee, for which the original approved estimate was $305,000, there has been appropriated $300,000, so that an additional $5,000 is needed to complete the work.

For Rock Island Harbor the estimate is $25,000, and $10,000 has been appropriated. The balance of the $15,000 is needed to complete the improvement.

July 1, 1899, balance unexpended		$1,300,429.47
Allotted from appropriation in sundry civil act of June 6, 1900		150,000.00
		1,450,429.47
June 30, 1900, amount expended during fiscal year		809,378.84
July 1, 1900, balance unexpended		641,050.63
July 1, 1900, outstanding liabilities	$10,712.62	
July 1, 1900, amount covered by uncompleted contracts	295,655.80	
		306,368.42
July 1, 1900, balance available		334,682.21
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		750,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix A A 2.)

3. *Operating and care of Des Moines Rapids Canal and Dry Dock.*—During the past fiscal year the Des Moines Rapid Canal was open for navigation 237 days, during which time there passed through it 882 steamboats and 381 barges, carrying 27,488 passengers, 25,105 tons of merchandise, and 6,902 bushels of grain. There also passed through the canal 78,857,657 feet, B. M., of lumber, 32,142,550 feet of logs, 24,564,771 shingles, and 18,502,200 laths.

The draft afforded by the canal is 5 feet at extreme low water, which may be increased to 6 feet at higher stages.

The dry dock was in constant use during the whole year.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by acts of March 3, 1881, and July 5, 1884.

The amount expended during the year was $39,120.73.

(See Appendix A A 3.)

4. *Operating and care of Galena River improvement, Illinois.*—This improvement, consisting of a lock and dam in the Galena River, was purchased by the United States in March, 1894, under provisions of act of Congress of September 19, 1890, at a cost of $100,000.

During the past fiscal year the lock was open for navigation 220 days, in which time there passed through it 539 boats and barges, carrying 2,045 passengers and 764 tons of merchandise.

Considerable dredging in the pool between the lock and Galena was done during the summer and fall of 1899.

The draft that can be carried at extreme low water is 2 feet, as limited by the depth on the lower miter sill of the lock.

The cost of operating and care of the improvement is provided for under indefinite appropriation made by act of Congress approved July 5, 1884.

The amount expended during the year was $8,750.94.

(See Appendix A A 4.)

5. *La Crosse Harbor, Wisconsin.*—The approved project contemplates the construction of a lateral bulkhead 1,575 feet long, a cross dam 450 feet long, and a certain amount of filling between lateral bulkhead and shore. By this means it is hoped to provide 800 linear feet of good landing. The full amount of the estimate has been appropriated

and no further funds are asked for. Work on the lateral bulkhead was commenced June 15 and continued to end of fiscal year.

July 1, 1899, balance unexpended	$17,000.00
June 30, 1900, amount expended during fiscal year	815.69
July 1, 1900, balance unexpended	16,184.31

(See Appendix A A 5.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and survey of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. (now Major) C. McD. Townsend, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. J. W. Barlow, Corps of Engineers:

1. *Preliminary examination of Mississippi River in the vicinity of Quincy, Ill., with a view to prevent the filling up of Quincy Bay.*—Captain Townsend submitted report April 4, 1899. For reasons given, he states that improvement of the locality is not advisable, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 38, Fifty-sixth Congress, first session. (See also Appendix A A 6.)

2. *Preliminary examination of Mississippi River at Bellevue, Iowa, with a view to the construction of a dam on the Illinois shore across Crooked Slough.*—Captain Townsend submitted report April 12, 1899. He states that it appears proper at the present time to build a dam or causeway across Crooked Slough and that funds on hand are sufficient to permit its construction. The report was transmitted to Congress and printed in House Doc. No. 83, Fifty-sixth Congress, first session. (See also Appendix A A 7.)

3. *Preliminary examination and survey of east shore of Lake Pepin, Mississippi River.*—Captain Townsend submitted reports dated March 23 and April 26, 1899, respectively, with plan for improvement at an estimated cost of $14,000. The reports were transmitted to Congress and printed in House Doc. No. 112, Fifty-sixth Congress, first session. (See also Appendix A A 8.)

CONSTRUCTION OF RESERVOIRS AT HEAD WATERS OF MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER FROM ST. PAUL TO MINNEAPOLIS, MINN.; OF RIVERS IN WISCONSIN AND MINNESOTA TRIBUTARY TO MISSISSIPPI RIVER; OF WARROAD RIVER, MINNESOTA, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT ST. PAUL, MINN.

This district was in the charge of Maj. Frederic V. Abbot, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. *Mississippi River between St. Paul and Minneapolis, Minn.*—In its natural condition this channel in its upper portions can only be navigated at low water by very small boats, and at higher stages the current is so swift in places as to make all navigation difficult. The improvement of this section of the river by the construction of locks and dams was inaugurated by the river and harbor act of August 18, 1894, which provided for commencing the construction of Lock and

Dam No. 2, located near Meekers Island. The estimated cost of this lock and dam was $598,235, and there had been expended on its construction up to June 30, 1899, $112,076.40.

The river and harbor act approved March 3, 1899, authorized the completion of Lock and Dam No. 2, together with Lock and Dam No. 1, under continuing appropriations, at a cost in addition to an appropriation of $150,000 of not to exceed $815,579.33.

On June 30, 1899, the cofferdam for Lock No. 2 was nearly finished. During the past year the lock excavation has been nearly completed, a large part of the timber floor of the lock chamber has been laid, contracts for both upper and lower lock gates have been let, as also for the cement for lock walls. Detailed plans have been prepared and approved by a Board of Engineers. As was anticipated, much trouble has been caused by large water-bearing seams in the sand rock underlying the lock site. No effect on the navigable channel can result till both the lock and dam are completed.

July 1, 1899, balance unexpended		$238,801.27
Amount appropriated by sundry civil act approved June 6, 1900		185,000.00
		423,801.27
June 30, 1900, amount expended during fiscal year		124,020.27
July 1, 1900, balance unexpended		299,781.00
July 1, 1900, outstanding liabilities	$36,264.77	
July 1, 1900, amount covered by uncompleted contracts	17,153.00	
		53,417.77
July 1, 1900, balance available		246,363.23
Amount (estimated) required for completion of existing project		630,579.33
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		157,357.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix B B 1.)

2. *Construction of reservoirs at head waters of Mississippi River.*—The object of these reservoirs is to collect surplus water, principally from precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation on the Mississippi River below the reservoir dams.

Dams have been constructed as follows: At Lake Winnibigoshish, Leech Lake, Pokegama Falls, Sandy Lake, and Pine River.

The total amount expended to the close of the fiscal year ending June 30, 1899, was $890,508.03. These expenditures cover cost of construction of five dams and their operating machinery, of superintendence and contingencies, of certain awards for damages, and of repairs; also of operating the dams up to February 1, 1895.

The expenditure has resulted in some benefit during the low-water season to the navigable portions of the Mississippi River from Grand Rapids, Minn., to the confluence of the Mississippi and St. Croix rivers, about 22 miles below St. Paul.

The reasons given in the Annnal Report of the Chief of Engineers for 1897, page 1681 et seq., for limiting the system to the reservoirs now actually constructed, have become more forcible as the country has been settled and lands have increased in value. The policy for the future should be to replace the present timber structures, which are annually becoming more and more decayed, by permanent dams of concrete or masonry, to define by proper surveys the areas which the United States actually owns, and to acquire by purchase flowage rights over the large areas which, without any legal right, are now annually overflowed by the filling of the reservoirs, and the estimate presented contemplates such work.

During the year a number of tracts of land, lying below Pokegama Falls dam, overflowed by the operation of that dam, and to which it was not possible to secure valid title by ordinary methods, were condemned. At the close of the fiscal year the court proceedings were not entirely complete.

The repairs to the dam at Lake Winnibigoshish are approaching completion. The new dam will, when completed, be a concrete and steel structure.

The dam at Leech Lake is also undergoing repairs which will result in its conversion into a steel and concrete dam. Pine River dam is getting very rotten and should be replaced by a suitable concrete and steel dam with suitable sluiceways, at a cost of $100,000 as soon as the work at Leech Lake is completed. Pokegama Falls dam will require similar treatment within the next two or three years, and the cost will be the same as at Pine River. It is estimated that $75,000 will be required for the title to lands which are now submerged by the operation of the reservoirs without any legal right. The exact sum can not be given till the completion of the surveys shows just the areas needed. It is estimated that the sum of $300,000 will be needed in addition to funds already appropriated to complete the repairs outlined above, to purchase the flowage rights, and to complete the surveys.

The total expenditures for the reservoir dams, including repairs, etc., aggregate to June 30, 1900, $1,013,883.48, of which sum $123,375.45 has been spent since June 30, 1899.

A large part of the flowage area consists of Indian lands. These are soon to be opened to settlement, and as the damages have been paid to the Indians in a lump sum appropriation it is very essential to have detailed descriptions of the various tracts overflowed filed before the title becomes involved. Descriptions based on the incomplete surveys then in the possession of the War Department were transmitted to the Secretary of the Interior in 1898. New and accurate descriptions will be prepared and transmitted to that Department as soon as the extensive surveys now partially executed are completed.

July 1, 1899, balance unexpended	$224,991.97
June 30, 1900, amount expended during fiscal year	123,375.45
July 1, 1900, balance unexpended	101,616.52
July 1, 1900, outstanding liabilities	21,558.81
July 1, 1900, balance available	80,057.71
Amount (estimated) required for completion of existing project	[1]300,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for renewals and lands, in addition to the balance available July 1, 1900	222,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix B B 2.)

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[1] Required for renewal and repair of reservoir dams.

3. *Operating and care of reservoirs at head waters of Mississippi River.*—The river and harbor act of August 18, 1894, made applicable to the reservoirs at head waters of Mississippi River, "so far as concerns their care, preservation, and maintenance," the provisions of the general appropriation for "operating and care of canals and other works of navigation, indefinite," contained in section 4 of the river and harbor act of July 5, 1884. The first allotment was made January 25, 1895, and the expenses from February 1, 1895, have been paid from the indefinite appropriation.

During the past fiscal year ordinary repairs to the dike at Winnibigoshish and to Pokegama and Pine River dams were made. The road connecting Leech Lake and Winnibigoshish dams was repaired.

The amount, excluding liabilities, expended for operating and care of these reservoirs up to June 30, 1899, was $104,047.14.

The amount, excluding liabilities, expended in care and maintenance of these reservoirs during the past year was $19,378.23.

(See Appendix B B 3.)

4. *Chippewa River, including yellow banks, Wisconsin.*—The original low-water depth did not exceed a foot and a half, and the channels were narrow; at the mouth the depth did not exceed a foot. The first examinations and surveys were made in 1874. The project included revetment of caving banks and the construction of spur dams from Eau Claire to the mouth, a distance of 56 miles. The estimated cost was $139,892.50. The estimate has been revised three times. The last (1888) is $272,487.72.

The total expenditures from the beginning in 1877 to June 30, 1899, aggregate $192,012.50.

On June 30, 1899, the work had resulted in a 3-foot depth at the mouth and improved depths elsewhere. A depth of 3 feet exists wherever the dams are fully completed.

The work of the past year has been largely repairs. Where new work was done 3-foot depths have been secured.

The river traffic at present is confined to the rafting of manufactured lumber and the running of loose logs. The annual tonnage of rafted lumber is about 300,000 tons and of loose logs about 1,000,000 tons.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the river under improvement was 18 inches.

July 1, 1899, balance unexpended	$9,737.50
June 30, 1900, amount expended during fiscal year	8,628.60
July 1, 1900, balance unexpended	1,108.90
July 1, 1900, outstanding liabilities	182.74
July 1, 1900, balance available	926.16
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	70,737.72

(See Appendix B B 4.)

5. *St. Croix River, Wisconsin and Minnesota.*—Before the improvement was begun the low-water depth in the channel above Lake St. Croix was but 2 feet on many of the bars. In Lake St. Croix and below, the channel over Hudson and Catfish bars was narrow and tortuous.

The project for improvement contemplates removal of snags, bowlders, bars, etc., and the contraction of the low-water channel from Taylors Falls to the head of Lake St. Croix; widening and straightening the channel where it is narrow or tortuous in Lake St. Croix by dredging and contraction works; also the improvement of the harbor and water front of Stillwater, Minn.

The object of the improvement is to furnish an open channel, 3 feet deep, from Taylors Falls to the confluence with the Mississippi River, 52.3 miles, and better harbor facilities at Stillwater. The estimated cost is $136,700. The river and harbor act of June 3, 1896, allotted from the general appropriation for the river the sum of $10,000, to be used in improving Stillwater Harbor, the upper part of Lake St. Croix.

The total expenditures to June 30, 1899, were $127,583.01.

By June 30, 1899, the projected work at Stillwater and between Stillwater and the mouth had been accomplished, but above Stillwater little effect had been produced.

During the past year the dredge has been improved and some dams have been built near Taylors Falls. Time has not yet elapsed for their effect to be fully developed.

The commerce of the river at present consists of loose logs, tows of lumber, and log rafts. The total tonnage passing over the river is approximately 2,000,000 tons per annum.

From 10,000 to 40,000 passengers make the trip from Taylors Falls to Stillwater each year on a small steamer. The scenery is attractive, and the round trip from Minneapolis or St. Paul can be made in one day.

A controversy between the loggers and steamboat men on the Upper St. Croix has been in progress for the past three years. It resulted in the passage of the act of Congress approved May 9, 1900, entitled "An Act authorizing the Secretary of War to make regulations governing the running of loose logs, steamboats, and rafts on certain rivers and streams."

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the river under improvement was 3 feet at and below Stillwater and 2 feet above Stillwater.

July 1, 1899, balance unexpended	$8,916.99
June 30, 1900, amount expended during fiscal year	3,826.49
July 1, 1900, balance unexpended	5,090.50
July 1, 1900, outstanding liabilities	770.09
July 1, 1900, balance available	4,320.41
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix B B 5.)

6. *Minnesota River, Minnesota.*—The river and harbor act of March 3, 1899, provided $1,000 for removing the bar at the mouth of this river.

Originally there was 1 foot of water on this bar at low water. The project provided for simple dredging. The estimated cost was $500 every year for maintenance.

The total amount expended on the entire river up to June 30, 1899, was $131,499.25, but nothing had been expended under the present project. At that date there was a depth of 1 foot only on the bar at low water. During the past fiscal year $692.08 has been expended in simple dredging, and there is now a depth of 3 feet at low water, of sufficient width for the use of small steamers. This increase in depth is purely temporary, as the next flood in the Mississippi will probably entirely obliterate the artificial cut.

There has been no commerce on the river during the past year.

July 1, 1899, balance unexpended	$1,000.75
June 30, 1900, amount expended during fiscal year	692.08
July 1, 1900, balance unexpended	308.67
July 1, 1900, outstanding liabilities	3.99
July 1, 1900, balance available	304.68

(See Appendix B B 6.)

7. *Red River of the North, Minnesota and North Dakota.*—When the improvement of this river began the navigation of the reach from Breckenridge to Moorhead (97 miles) was difficult at all stages, and impossible at low water. The second reach, from Moorhead to Grand Forks (155 miles), had a ruling depth at low water of 1.5 feet. The third reach, from Grand Forks to the boundary line of the United States (143.5 miles), had a ruling low-water depth of 2 feet. The low-water navigation of Red Lake River was obstructed by bowlders between Thief River Falls and High Landing, a distance of 35 miles, and by a bad bar at its connection with Red Lake.

The present project is the same as the original (adopted December, 1877), except that an open-channel improvement was substituted in 1886, by act of Congress, for the proposed lock and dam at Goose Rapids, and the improvement of Red Lake River between Thief River Falls and Red Lake was added by the terms of the river and harbor act of Congress of June 3, 1896.

The object of the improvement is to provide an open channel on the Red River of the North from Breckenridge to the northern boundary line, 395.5 miles, as follows:

1. Breckenridge to Moorhead (97 miles), a channel capable of being navigated during high and medium stages of water.
2. Moorhead to Grand Forks (155 miles), a channel 50 feet wide and 3 feet deep at low water.
3. Grand Forks to the northern boundary line (143.5 miles), a channel 60 feet wide and 4 feet deep at low water.

Also to provide a 3-foot open-channel improvement of the Red Lake River and Red Lake from Thief River Falls to and including Red Lake, a total distance of 135 miles.

The original estimated cost was $364,598.17, increased in 1883 to $398,598.17. The estimate was revised in 1887, after Congress had substituted an open-channel improvement for lock and dam at Goose Rapids, and placed at $252,598.37. An increase of the latter was authorized May 8, 1893, to $310,320. Congress, in 1896, added $5,000 to the estimate of cost by attaching the improvement of Red Lake River to the project. In 1899 $4,000 of the $10,000 authorized was allotted to Red Lake River, so that the present estimate of cost is $319,320 for both rivers from the beginning of operations.

The total amount expended to June 30, 1899, including work on Red Lake River, was $277,819.92.

On June 30, 1899, the object had not been obtained on the first division of the Red River of the North, which has for some years been closed against all navigation by permanent pile bridges. The Secretary of War has approved leaving these bridges as they stand, as there was no navigation affected thereby. The object was obtained on the third division and on all but 13 miles of the second, but annual dredging will be needed to maintain the depth. On Red Lake River 104 cubic yards of bowlders had been removed.

During the past year dredging has been done near Grand Forks, both above and below, and within 20 miles in either direction.

On the Red River of the North the expenditures for the past fiscal year have been $12,735.32.

On Red Lake River the expenditures for the last fiscal year have been $2,192.50, for removing bowlders and overhanging trees.

Navigation on Red River is confined to comparatively short reaches north and south of Grand Forks, and consists mainly in the transportation of wheat to Grand Forks by two steamboats (100 and 12 tons, respectively) and 6 barges. The tonnage during the year 1899 was 30,405.

On Red Lake River three steamers of 50 tons each were operated, carrying general merchandise and passengers, the total tonnage in 1899 being 977, and 5,944 passengers. Ninety-three million feet B. M. of logs were run on the river during the year. Three steamboats are run on Red Lake towing logs, the quantity moved being about 60,000,000 B. M. feet.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the river under improvement was nothing on the first division of Red River of the North, 2 feet on the undredged 13 miles of the Red River of the North, and 18 inches on Red Lake River.

July 1, 1899, balance unexpended	$25,185.08
June 30, 1900, amount expended during fiscal year	14,927.82
July 1, 1900, balance unexpended	10,257.26
July 1, 1900, outstanding liabilities	1,158.88
July 1, 1900, balance available	9,098.38
Amount (estimated) required for completion of existing project	16,320.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix B B 7.)

8. *Improvement of bar at mouth of Warroad River, Minnesota.*—The river and harbor act of March 3, 1899, contains the following item: "For removing a sand bar at the mouth of Warroad River, Minnesota, three thousand dollars, or so much thereof as may be necessary." As no previous information was available regarding this locality, a survey of the mouth of the river was made. Based on this survey, the district officer has presented a project and estimate of cost, which will be submitted to Congress as an executive document. The original depth is about 4½ feet. Up to June 30, 1899, $195.95 had been spent simply for surveys. During the past year $386.44 has

been spent completing the surveys. The depth at the bar has, of course, not been affected as yet. Four and a half feet can be carried over the bar with the Lake of the Woods at a stage of 7 feet, on an arbitrary gauge established in the spring of 1899. No reliable information exists as to what the low-water stage of the lake is.

The commerce for the past year has aggregated about 600 tons.

July 1, 1899, balance unexpended	$2,804.05
June 30, 1900, amount expended during fiscal year	386.44
July 1, 1900, balance unexpended	2,417.61
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	[1]

(See Appendix B B 8.)

9. *Gauging Mississippi River at or near St. Paul, Minn.*—The river and harbor act of August 11, 1888, authorized the gaugings, but none were made until the fall of 1889. Since the latter date gaugings have been made as frequently as the funds available would permit and the condition justified the expenditure.

Amount expended to June 30, 1899, $5,400.

The records indicate that a rise in the river at St. Paul commences in seven or eight days following the release of the water from the distributing reservoir at Pokegama Falls, and in about five days thereafter the full effect is felt. The mean time is, therefore, ten days.

July 1, 1899, balance unexpended	$500.00
June 30, 1900, amount expended during fiscal year	320.06
July 1, 1900, balance unexpended	[2] 179.94

(See Appendix B B 9.)

10. *Survey of Red Lake and Red Lake River, Minnesota.*—The survey of Red Lake and Red Lake River, Minnesota, with a view to the construction of a dam with locks at the outlet of said lake for the purpose of improving the navigation of the Red River of the North and said Red Lake River, Minnesota, and estimating the cost of said improvement, required by the river and harbor act approved March 3, 1899, was inaugurated by Maj. Frederic V. Abbot, Corps of Engineers, and a preliminary report thereon was submitted April 27, 1900. Final report can not be made until a sufficiently prolonged record of the run-off has been secured.

The preliminary report was transmitted to Congress and printed in House Doc. No. 671, Fifty-sixth Congress, first session. It is also submitted herewith as a part of Appendix B B 10.

July 1, 1899, balance unexpended	$4,819.61
June 30, 1900, amount expended during fiscal year	3,325.94
July 1, 1900, balance unexpended	1,493.67
July 1, 1900, outstanding liabilities	355.00
July 1, 1900, balance available	1,138.67

(See Appendix B B 10.)

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[1] No recognized project in force.

[2] Returned to Treasury, June, 1900.

11. Survey of Otter Tail Lake and Otter Tail River, Minnesota.—The survey of Otter Tail Lake and Otter Tail River, Minnesota, with a view to the construction of a dam at the outlet of said lake for the purpose of improving the navigation of the Red River of the North, Minnesota, and estimating the cost of said improvement, required by the river and harbor act approved March 3, 1899, was inaugurated by Maj. Frederic V. Abbot, Corps of Engineers, and a preliminary report was submitted thereon April 27, 1900. Final report can not be made until a sufficiently prolonged record of the run-off has been secured.

The preliminary report was transmitted to Congress and printed in House Doc. No. 672, Fifty-sixth Congress, first session. It is also submitted herewith as a part of Appendix B B 11.

July 1, 1899, balance unexpended	$2,776.15
June 30, 1900, amount expended during fiscal year	798.04
July 1, 1900, balance unexpended	1,978.11
July 1, 1900, outstanding liabilities	60.00
July 1, 1900, balance available	1,918.11

(See Appendix B B 11.)

12. Survey of Big Stone Lake and Lake Traverse, Minnesota and South Dakota.—The survey of Big Stone Lake and Lake Traverse, Minnesota and South Dakota, with a view to construct reservoirs therein for the improvement of the navigation of the Minnesota River, and an estimate of the cost of such improvements, required by the river and harbor act approved March 3, 1899, was inaugurated by Maj. Frederic V. Abbot, Corps of Engineers, and a preliminary report thereon was submitted April 26, 1900. Final report can not be made until a sufficiently prolonged record of the run-off has been secured.

The preliminary report was transmitted to Congress and printed in House Doc. No. 675, Fifty-sixth Congress, first session. It is also submitted herewith as part of Appendix B B 12.

July 1, 1899, balance unexpended	$4,871.75
June 30, 1900, amount expended during fiscal year	702.71
July 1, 1900, balance unexpended	4,169.04
July 1, 1900, outstanding liabilities	126.00
July 1, 1900, balance available	4,043.04

(See Appendix B B 12.)

EXAMINATIONS AND SURVEYS REQUIRED BY THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. Frederic V. Abbot, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. J. W. Barlow, Corps of Engineers:

1. Preliminary examination and plan and estimate for improvement of St. Croix River, from Stillwater Harbor to Taylors Falls, Minnesota.—Major Abbot submitted reports dated March 25 and July 14, 1899, respectively, with plan for improvement at an estimated cost of $1,000 per annum. The reports were transmitted to Congress and printed in House Doc. No. 104, Fifty-sixth Congress, first session. (See also Appendix B B 13.)

2. Preliminary examination of Minnesota River, with a view of protecting the banks at or near St. Peter, in Nicollet County, Minn.—Major Abbot submitted report April 24, 1899. In his opinion the river at this point is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 78, Fifty-sixth Congress, first session. (See also Appendix B B 14.)

3. Preliminary examination of Red River of the North, Minnesota, and North Dakota.—Major Abbot submitted report May 2, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government in the manner indicated in the act. The report was transmitted to Congress and printed in House Doc. No. 67, Fifty-sixth Congress, first session. (See also Appendix B B 15.)

Major Abbot was also charged with the duty of making surveys of the following localities, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Mississippi River, between the Government dam at Sandy Lake and Brainerd, Minn.

2. Flowage lines of Winnibigoshish, Leech Lake, Pokegama Falls, and Pine River reservoirs, Mississippi River.

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Warroad Harbor and Warroad River, Minnesota.

2. Long Prairie River and its sources, Minnesota.

EXAMINATION AND SURVEY OF MISSOURI RIVER AT HUNTSDALE, MO., AND AT NAPOLEON, MO., MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the act of March 3, 1899, were made under the direction of Lieut. Col. Amos Stickney, Corps of Engineers, president of the Missouri River Commission, and reports thereon submitted:

1. Preliminary examination and survey of Missouri River at Huntsdale, Mo., with a view to prevent the erosion of the north bank thereof.—Lieutenant-Colonel Stickney submitted reports dated July 25, 1899, and January 3, 1900, respectively. In his opinion the locality is worthy of improvement by the General Government, and he presents a plan for protection of this reach of the river at an estimated cost of $185,250. The reports were transmitted to Congress and printed in House Doc. No. 285, Fifty-sixth Congress, first session. (See also Appendix C C 1.)

2. Preliminary examination and survey of Missouri River at Napoleon, Mo., with a view to prevent the erosion of the south bank thereof and the cutting of a new channel.—Lieutenant-Colonel Stickney submitted reports dated July 25, 1899, and January 6, 1900, respectively. In his opinion the work is worthy of being undertaken by the United

States, and he presents a plan for rectification of the river from Fishing River to Camden, Mo., at an estimated cost of $385,000. The reports were transmitted to Congress and printed in House Doc. No. 310, Fifty-sixth Congress, first session. (See also Appendix C C 2.)

IMPROVEMENT OF MISSOURI RIVER AT AND ABOVE SIOUX CITY, IOWA, AND OF YELLOWSTONE RIVER, MONTANA AND NORTH DAKOTA.

This district was in the charge of Capt. J. C. Sanford, Corps of Engineers, to October 17, 1899, and of Capt. H. M. Chittenden, Corps of Engineers, since that date. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Missouri River, between Stubbs Ferry, Montana, and the lower limits of Sioux City, Iowa.—The river distance between the above points is 1,660 miles. By its physical characteristics this portion of the river is divided into four sections: The first, Stubbs Ferry to Greatfalls, Mont., 130 miles, is the navigable portion above the "Great Falls;" the second, Greatfalls to Fort Benton, Mont., 49 miles, is an unnavigable section, occupied by cataracts and dangerous rapids; the third, Fort Benton to Carroll, Mont., 172 miles, known as the "Rocky River," contains numerous rapids and rock obstructions, but has carried a heavy commerce; the fourth, Carroll to Sioux City, 1,309 miles, known as the "Sandy River," is characterized by muddy water, sand bars, and a shifting channel, with easily eroded and constantly eroding banks. Navigation is difficult at low water, due to the too great width of the river in many places. The upper 158 miles forms a transition portion between the "Rocky" and "Sandy" rivers.

For work above Fort Benton there has been no appropriation since June 3, 1896, and the work has been dropped from the list of those requiring regular reports.

Between Fort Benton and Carroll work has been carried on at the following points:

At Fort Benton, Mont.—The river and harbor act of March 3, 1899, appropriated $5,000 for repairing the levee at Fort Benton and confining the river within its present limits. Under a project for the expenditure of above amount, approved January 23, 1900, work has just been begun, but nothing has been done except to arrange for the necessary purchases of materials. The work will be completed during the present season.

Amount expended during fiscal year ending June 30, 1900, $151.22.

At Judith, Mont.—The river and harbor act of March 3, 1899, appropriated $5,000 for repairing the south bank of the river at Judith, Mont. Under a project for the expenditure of above amount, approved July 19, 1899, work has just been begun, but nothing has been done except to arrange for the necessary purchase of materials. The work will be completed, so far as the appropriation will permit, during the present season.

Amount expended during fiscal year ending June 30, 1900, $115.94.

Between Carroll and Sioux City work has been carried on at the following points:

At Bismarck Harbor.—The high-water channel above and below Bismarck was of excessive width, being divided by several bars and islands. The channel shifted frequently, rendering erosion liable to occur at almost all points on either bank throughout the reach. A serious erosion of the right bank a short distance above the bridge was in progress, where the river threatened to break through into the Heart River.

Under a project for the expenditure of the allotment of $40,000, made by the river and harbor act of August 18, 1894, 7 pile dikes had been built in 1895 to check this erosion. The project formed part of a general plan, submitted at the same time, for the rectification of the river for about 5 miles above and 5 miles below Bismarck, at an estimated cost of $725,000. The dikes have been damaged by ice, drift, and high water in each spring since their construction. The damage done in the spring of 1896 was partially repaired in May of that year under transfer of $2,328.21 from balances of the appropriations of 1890 and 1892.

Under a project adopted September 29, 1896, for the expenditure of the allotment of $32,000 from the appropriation of June 3, 1896, one right-bank dike was built below this group to control the channel as it approached the bridge, two short left-bank dikes were built just below the bridge, and the left bank was revetted for about 500 feet below the warehouse at the steamboat landing.

The project adopted May 27, 1899, for expenditure of the allotment of $40,000 from the appropriation of March 3, 1899, provides for repairing existing works, constructing a dike and revetment on the right bank above the bridge, if found necessary, and continuing downstream, so far as funds will permit, the left-bank protection below the bridge. The left bank at the steamboat landing for a length of 226 feet was temporarily protected in June, 1899, by brush fascines and rock.

To June 30, 1899, $74,934.84 had been expended at this locality. Further erosion at the site of the works built had been prevented and a large increase in depth of accretion between the inner portions of the 1895 dikes had been gained.

Amount expended during the fiscal year ending June 30, 1900, $36,537.78.

On the right bank the group of dikes constructed above the bridge in 1895 has been repaired, and 1,913 linear feet of bank has been protected by revetment. On the left bank below the bridge 500 linear feet of bank just above the railroad warehouse has been protected by revetment, and 900 linear feet of bank below the revetment constructed in 1897 has been protected by revetment. Materials have been purchased for the construction of two barges.

At Pierre and Fort Pierre.—The river here for about 7 miles, extending from above Pierre to below Fort Pierre, was of excessive width, being divided by numerous islands and bars. The low-water channel was liable at times to occupy any place between the high-water banks, and the latter were liable in places to erosion. The steamboat landing at Pierre had silted up, erosion had occurred on the Pierre front below it, and the Fort Pierre front was cutting badly. The crossing between Pierre and Fort Pierre was very shoal and changeable in position.

Under a project for the expenditure of the allotment of $40,000, made by the river and harbor act of August 18, 1894, 5 dikes were, in 1895, built in front of Fort Pierre. One dike in front of Pierre was completed and a second dike partly completed, and a dam built closing the chute behind Marion Island. The project formed part of a general plan submitted at the same time for the rectification of the above 7 miles of river in this locality, at an estimated cost of $360,000. In 1896–97, under a project adopted July 24, 1896, modified October 3, 1896, for the expenditure of the allotment, $40,000, from the appropriation of June 3, 1896, the second dike at Pierre was completed, and a third dike below it begun and carried out a short distance, to cut off a chute; the Fort Pierre front was revetted from Bad River to the bluff contact below, about 2,830 feet; two dikes and a revetment, about 1,220 feet in length, were built to protect the lower part of Marion Island; and the Marion Island Dam was twice repaired.

In July, 1898, slight injuries done to the Marion Island revetment by the June rise were repaired. During the unusually high water in the spring of 1899, the head of Marion Island was washed away to nearly opposite the dam, and a channel about 300 feet wide cut between the dam and the island. Cutting on the Pierre side threatened the waterworks. Some of the existing works were more or less injured. Temporary brush and rock protection was, in June, 1899, placed at the head of Marion Island and on the Pierre side near the waterworks, to check erosion during the high water.

The project adopted June 19, 1899, for the expenditure of the allotment of $40,000 from the appropriation of March 3, 1899, provides for protecting the head of Marion Island and closing the chute behind it; for extending the present Marion Island revetment to the foot of the island; for repairing the present works and raising the shore ends of the dikes at Pierre; and for constructing so much of two proposed dikes on the Pierre side as remaining funds will permit.

To June 30, 1899, $79,888.25 had been expended at this locality. The works had prevented the destruction of much valuable land and other property which would otherwise have occurred during the spring of 1899. The crossing between Pierre and Fort Pierre remains in good condition.

Amount expended during fiscal year ending June 30, 1900, $26,817.79.

The head of Marion Island has been protected by 1,790 linear feet of revetment and the Marion Island Dam has been extended 300 feet and the whole dam is being extensively repaired and strengthened and raised above high water, the chute behind the island being closed thereby. Materials have been purchased for the construction of two barges. The plant has been repaired.

At Yankton.—The river in the vicinity of Yankton is of excessive width, and its channel is constantly shifting. Due to changes in its position in the last few years, a wide bar has formed in front of the steamboat landing. No work of improvement had been done by the General Government in this vicinity prior to the act of June 3, 1896.

The original project, adopted March 23, 1897, based on a survey of the reach made in October, 1896, provides for the expenditure of the allotment of $32,000 from the appropriation of June 3, 1896, in fairing out and protecting the left bank above the site of the proposed bridge, about 3½ miles above Yankton. The work forms part of a general plan, submitted at the same time, for rectification of about 6.5 miles of the river in this vicinity, with a view to restoring the steamboat landing and to controlling the river in the vicinity of the proposed bridge, at an estimated cost of $296,800. As it had become evident in the summer of 1897 that the construction of the bridge would probably not be begun in the near future, a revised project for the expenditure of the allotment was submitted (approved September 3, 1897), providing for beginning the construction of the right-bank group of dikes above Yankton proposed in the general plan for the purpose of restoring the steamboat landing.

To June 30, 1899, $32,075.98 had been expended. Six of the proposed right-bank dikes had been begun but had not been extended sufficiently to produce any decided effect in the position of the channel. Five of the dikes were damaged in the spring of 1899, and some erosion of the right bank in their vicinity had occurred.

The project adopted April 19, 1899, for the expenditure of the allotment of $40,000 from the appropriation of March 3, 1899, provides for continuing the construction of these dikes.

Amount expended during fiscal year ending June 30, 1900, $36,229.42.

The two lower dikes constructed in 1897–98 have been extended, and a new dike has been constructed to replace dike 4, destroyed by ice in April, 1899, 2,450 linear feet of three-row dike being constructed during the year. The river channel has been forced over by the dikes toward the Yankton side, but not sufficiently to restore the steamboat landing. One pile driver and two barges have been constructed, and the plant has been repaired.

At Elkpoint.—The left bank at this locality was cutting rapidly, and it was feared by the citizens that the town, although nearly 2 miles from the river, was in danger, either by direct erosion of the intervening land or by the river cutting into and occupying an old bed which ran by the town.

No work had been done prior to 1896. In October and November of that year a survey of the reach was made. A project for the expenditure of the allotment of $20,000 from the appropriation of June 3, 1896, was submitted February 8, 1897, providing for beginning the protection of the left bank in front of Elkpoint and forming part of a general plan, submitted at the same time, for the protection of about 10,100 feet of this bank, at an estimated cost of $87,300, with a possible additional cost of $34,500 should the heading be threatened with flanking due to changes in the channel above. It was decided that the funds should be retained in the Treasury until, by additional appropriation, the work could be carried on in safety.

The project adopted June 22, 1899, for the expenditure of the allotment of $20,000 from the appropriation of March 3, 1899, together with the balance from the appropriation of June 3, 1896, provides for beginning the protection of the left bank opposite the town, the works to consist of revetment and, where necessary to fair out the shore line, of short permeable dikes.

To June 30, 1899, $389.24 had been expended at this locality.

Amount expended during fiscal year ending June 30, 1900, $24,142.48.

Two thousand one hundred and twenty-four linear feet of bank has been protected from erosion by revetment. Four barges have been constructed. A portion of the Sioux City plant has been repaired for use on this work.

Opposite Sioux City to opposite Elkpoint.—The Nebraska bank of the Missouri River in front of South Sioux City had been protected for about 4,000 feet upstream from the lower bridge and for about 5,400 feet upstream from the upper bridge by revetments constructed by the owners of the respective bridges. Between these two revetments about 4,270 linear feet of bank was unprotected and was being rapidly eroded. The present project, adopted July 24, 1896, contemplates the expenditure of the funds provided by the river and harbor act of June 3, 1896, in revetting this unprotected bank, in repaving the upper bank for 300 feet farther upstream, and in protecting the head of the work by a short pile dike. The project contemplated the expenditure of $50,000, but as it was believed that the work could be done for the $40,000 allotted, no modification of the project was made. The work forms part of a general plan, described under the next heading, for the improvement of the river in this vicinity.

The revetment was completed in the fall of 1896 and the dike in March, 1897. During the latter year a combined pile driver and hydraulic grader and 4 skiffs were constructed and a towboat purchased, part of its cost being paid from the allotment for work at Yankton. This plant was intended for use in the lower part of the district as may be required.

To June 30, 1899, $40,539.99 had been expended in this locality.

The project adopted December 23, 1899, for the expenditure of the $25,000 appropriated by the river and harbor act of March 3, 1899, provides for protecting the right bank of the river with standard revetment used on this section of the river, from Jackson Chute as far down the river as funds will permit.

Amount expended during fiscal year ending June 30, 1900, $12,118.51.

Two thousand two hundred and eighty-eight linear feet of bank has been protected by revetment.

At Sioux City.—The river above Sioux City was extremely unstable. Several cut-offs had occurred in recent years, causing radical changes in channel, increased slope, and a large amount of erosion on banks opposite Sioux City. For the purpose of checking this erosion work was begun in 1878 and continued in each succeeding year until 1882. The works constructed were of an experimental type, and have since been destroyed or abandoned by the river.

In 1889 a group of 9 dikes was built at the center of the Sioux City front to check a dangerous erosion and fair out the bank line. In 1895 2 dikes were built just above this group and 2 dikes of the group strengthened. In the same year, under a project for the expenditure of $40,000 appropriated by the sundry civil act of March 2, 1895, a group of 16 short dikes had been built near the upper limits of the city to protect the bank there. This latter work formed part of a general plan submitted at the same time for the rectification of the river from about 2¾ miles above the mouth of the Big Sioux River to near the lower limits of the city, at an estimated cost for the portion below the Big Sioux River only of $400,000.

The present project, adopted June 10, 1897, for the expenditure of the $40,000 allotted from the appropriation of June 3, 1896, provides for protecting the lower portion of the city front (below the Floyd River), for making necessary repairs to existing dikes, and for applying the balance to such work as may afterwards be found necessary. The project is a modification of one adopted February 10, 1897, the change having been rendered necessary by marked changes of channel in the spring of 1897. A project providing for the expenditure of $50,000, adopted July 24, 1896, had been superseded by the latter.

Under the project of June 10, 1897, the Iowa bank, from the mouth of the Floyd River to a point about 7,400 feet below, had been protected by a revetment 824 feet in length and by 20 short pile dikes.

To June 30, 1899, $229,736.68 had been expended in this locality.

Amount expended during fiscal year ending June 30, 1900, $4.09.

The works built since 1889 are in fairly good condition, requiring only slight repairs. By a radical change in channel, which occurred in the summer of 1898, whereby the channel has shifted, at the Combination Bridge, across the full width of the high-water bed, the outer ends of the dikes built in 1889, now badly decayed, are exposed to the full force of the current. About 950 linear feet, in all, of these dikes has been destroyed, and a corresponding amount of the high accretion (in many places the dikes were completely buried) which had formed between them has been removed. These dikes are in such a condition that they can no longer be relied on to hold the accretion that has been gained.

Ice harbors.—Few good natural ice harbors exist on that portion of the Missouri River known as the "Sandy River," between Carroll, Mont., and Sioux City. The adopted project provides for the construction of two ice harbors, which were afterwards located at Rockhaven, near Mandan, N. Dak., and on the Big Sioux River (upper limits of Sioux City) near its confluence with the Missouri.

To June 30, 1899, $42,762.75 had been expended, by which the two ice harbors had been completed as provided in the project. There has been some erosion at the upper end of the Sioux ice harbor. At Rockhaven ice harbor there is only one place at which ways can be constructed and that is occupied by the Government. There is no place where private parties can construct ways to haul out their boats when necessary to protect them from ice. The removal of bars in front of the ice harbors and at the mouth of the Big Sioux River is frequently necessary to permit access to the harbors.

Total expenditures on the Missouri River between Stubbs Ferry and Sioux City to June 30, 1899, except for snagging, have been about $1,410,697.76. In addition about $10,000 was expended on the general river survey above Stubbs Ferry.

The existing balances will be used in continuing the work now in progress at the several points, and the estimates for the next fiscal year are intended to be applied in the same way. The work at none of these points has yet been carried far enough so that it can be abandoned without risk of loss of what has already been done.

July 1, 1899, balance unexpended	[1]$229,904.27
June 30, 1900, amount expended during fiscal year	136,406.50
July 1, 1900, balance unexpended	93,497.77
July 1, 1900, outstanding liabilities	9,905.89
July 1, 1900, balance available	83,591.88
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix D D 1.)

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[1] Increase of $7.98 over amount stated in 1899 report, explained as follows: Refundment of $7.53 by J. H. Owen, August 19, 1899; refundment of $0.45 by Capt. J. C. Sanford, Corps of Engineers, October 13, 1899.

2. *Improving Upper Missouri River by snagging.*—In its original condition the "Sandy River" between Carroll and Sioux City was greatly obstructed by snags; and to a less extent by loose rocks.

The original project, adopted in 1890, provides for removing the obstructions and the temporary improvement of the worst shoals, at an estimated cost of $50,000 annually. The work, begun in 1891, has been continued in each subsequent year under allotments and appropriations for this purpose.

The expenditures to June 30, 1899, were $348,106.96. Three snag boats had been constructed or purchased, and had been operated as funds permitted.

The river had been kept fairly clear of snags and obstructions over the portions used by commercial boats.

Three boats have been in commission during portions of the year, the aggregate time being equivalent to 321 days for one boat. The results were 848 snags and miscellaneous obstructions removed, 2,202 trees cut on caving banks and 5,095 miles of river passed over, the river passed over being fairly well cleared of snags and other obstructions.

A machine shop has been erected at the Sioux ice harbor, principally for use in repairing snag boats.

COMMERCIAL STATISTICS.

Amount of freight carried on the Missouri River above Sioux City, Iowa.

Calendar year.	Tons.	Calendar year.	Tons.
1887	13,961	1894	37,936
1888	12,895	1895	21,264
1889	16,723	1896	10,368
1890	14,072	1897	17,105
1891	14,211	1898	*a* 26,896
1892	17,292	1899	23,041
1893	19,481		

a Includes 700 tons carried above Greatfalls, estimated; also 1,000,000 feet B. M. lumber rafted above Stubbs Ferry, estimated.

No new lines of transportation were established during the fiscal year 1900.

July 1, 1899, balance unexpended	[1] $44,966.57
June 30, 1900, amount expended during fiscal year	28,040.34
July 1, 1900, balance unexpended	16,926.23
July 1, 1900, outstanding liabilities	3,119.84
July 1, 1900, balance available	13,806.39
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix D D 2.)

3. *Yellowstone River, Montana and North Dakota.*—Originally the channel below Miles City was greatly obstructed by rocks, rapids, bars,

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[1] Increase of $0.75 over amount stated in 1899 report, refundment by Capt. J. C. Sanford, Corps of Engineers, October 13, 1899.

and sharp turns, so that navigation was almost impossible at low water above Glendive and quite difficult below. The original project, adopted in 1879, contemplated rock removal and contraction works at shoals and a survey of the river. Since 1884 the work had been limited to the portion between Glendive and the mouth. No work was done under the project after 1885, navigation having ceased.

The total expenditures on the above general improvement were $122,029.59, including cost of surveys, $19,000. The results were to give a low-water depth of 3 feet or more at all points improved, but the works have since deteriorated and these depths do not now exist at all the improved points.

No appropriations for the general improvement of the Yellowstone River have been granted by Congress since 1886, and it is considered that the further improvement of this river has been abandoned. No further reports will be submitted.

July 1, 1899, balance unexpended	$11,720.41
July 1, 1900, balance unexpended (in Treasury)	11,720.41

EXAMINATION OF SIOUX RIVER, SOUTH DAKOTA, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Sioux River, South Dakota, for a dam for the storage of the water of said stream in Lake Kempeska and Lake Ponsett, together with an estimate of the capacity of said reservoir and the feasibility of utilizing the same*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY, AND OF OBION AND FORKED DEER RIVERS, TENNESSEE.

This district was in the charge of Lieut. Col. M. B. Adams, Corps of Engineers.

1. *Obion River, Tennessee.*—This stream is situated in northwestern Tennessee, taking its rise in Henry and Weakley counties. It has a north and south fork that unite about 85 miles above its mouth in the Mississippi River some 5 miles below the Missouri and Arkansas State line. The head of navigation is regarded as at Obion, Tenn., where it is crossed by the Illinois Central Railroad.

A report of a preliminary examination and of an instrumental survey of the Obion River is printed in the Annual Report of the Chief of Engineers for 1891, page 2292 et seq. The conditions that existed at the time of the survey appear to have been a little more favorable than were found in October, 1892, when improvements were undertaken. The report gave the width of channel as 150 feet, with an average low-water depth of 6 feet, and two shoals with 18-inch depths, between Obion, Tenn., and the mouth, 85 miles, whereas the general depth was found in October, 1892, to be only 5 feet, and there were some shoals with only 13-inch depths. Also the upper reaches were found to be greatly obstructed by snags, drift gorges, leaning trees, and by shoals formed in the drift gorges.

The original project, based on the above survey, had for its object the securing of a navigable low-water channel of not less than 3 feet in depth. It was proposed to clear the stream of snags, drift, and overhanging trees; to construct wing dams at the shoals and to straighten sharp bends; to do some grubbing and excavating, and to close the old channel in places where necessary, at an estimated cost of $50,000. Clearing the river of drift prior to 1896 was productive of a lowering of the water surface, however, and caused the officer then in charge to report (Annual Report of the Chief of Engineers for 1896, p. 1898) that he did not consider it possible to obtain the proposed 3-foot low-water depth by the method originally contemplated. He stated that a clear channel, free from snags, trees, etc., is all that can legitimately be expected, and that it would be fairly satisfactory, as the Mississippi backs into the Obion River and keeps it at a good stage a greater part of the year. The project appears to have been modified accordingly, June 1, 1897, and operations since then have been directed to the maintenance of a clear channel, free from snags, trees, etc., at a cost of some $2,500 per year. These operations have been productive of an improved channel between Obion, Tenn., and the mouth of the river, by the removal of the drift, snags, and obstructing timber. In 1893 a small steamboat, with tow, was enabled to ascend the river—the first in fifty years.

The only practicable method of doing the work has been found to be by hired labor.

The amount expended in these operations to the close of the fiscal year June 30, 1899, was $19,352.66.

During the fiscal year ending June 30, 1900, the work of removing surface obstructions was resumed, the snagging party moving upstream from mouth of Forked Deer River to Obion, Tenn., the head of navigation. The work done was as follows: Trees cut down, 368; trees deadened, 450; snags topped, 101; snags cut, 15; snags removed, 10. One hundred and ninety-four logs lying along banks were cut up to prevent being carried into the channel at high water.

In view of the fact that operations on the Obion and Forked Deer rivers are of precisely the same nature, as well as owing to some confusion that appears to have existed regarding the proper separation of the work on these streams, with their common channel for 3½ miles immediately above their common exit into the Mississippi, it is recommended by the officer now in charge that the two streams be hereafter considered together, being called the "Obion and Forked Deer rivers," and in appropriating for them that a sum equal to what is now separately allowed for the maintenance of each be appropriated as one item for the maintenance of both, as one stream. I concur in this recommendation.

The commerce of this stream consists principally of lumber cut by the numerous sawmills on or near the river and which reaches a market by way of the Mississippi River. So far as can be ascertained, the commerce during the calendar year of 1899 aggregated about 67,852 tons, having an estimated value of $484,889.77; passengers carried, 70. It is impracticable to yet complete accurate commercial statistics of such shipments, because records are not generally kept, and it is believed in this way a considerable amount of commerce is lost to the Government records. So far as can be ascertained, the improvements have given material aid to the lumber interests involved.

July 1, 1899, balance unexpended	$4,147.34
June 30, 1900, amount expended during fiscal year	618.43
July 1, 1900, balance unexpended	3,528.91
July 1, 1900, outstanding liabilities	20.24
July 1, 1900, balance available	3,508.67
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867; of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix E E 1.)

2. *Improvement of Forked Deer River, Tennessee.*—This stream carries off most of the precipitation that falls in Carroll, Gibson, Henderson, Madison, Chester, and Crockett counties, Tenn., and finds its exit now into the Mississippi River through the lower 3½ miles of the Obion River, and therefore joins its waters to the Mississippi about 5 miles below the Missouri and Arkansas State line. Some years ago (1845) it had a direct entrance into the Mississippi about 18 miles below the Obion's mouth, near Ashport, and its present course and change of mouth has been the result of cutting a canal to shorten the distance to the Mississippi.

The project for the improvement of this river provides for continuing the improvement by removing snags, cypress knees, logs, drift, leaning trees, and other surface obstructions, and including the removal of bars and shoals from Dyersburg, Tenn., to the Mississippi River, a distance of about 33 miles, so as to deepen the channel and make it navigable for crafts at a 3-foot stage or higher. This project was approved July 24, 1896, based on the provisions of the act of June 3, 1896 (see Annual Report of the Chief of Engineers for 1898, p. 1873).

These operations have been productive of an improved channel, though of course no increased depth of channel has resulted or is to be expected.

The only practicable method of carrying on the operations has been by day labor.

The amount expended to close of the fiscal year June 30, 1899, was $4,700.27; for maintenance, $985.36, and for general improvement North Fork, etc., $3,714.91; and the total amount expended to that date on improvement of the river and its forks, including the above, was $29,700.27.

During the fiscal year ending June 30, 1900, the channel was cleared from Dyersburg, Tenn., the head of navigation on North Fork, to the mouth of the Forked Deer River; 522 leaning trees were cut down; 459 snags cut; 385 logs removed; 352 logs lying along bank cut up to prevent being carried into channel during high water; 133 trees deadened.

The commerce of this stream and its navigable branches consisted principally of logs and timber products in rafts. Quite a number of flatboats have been used in connection with the steamboats during the year. During the calendar year of 1899, so far as could be ascertained, the commerce aggregated 50,770 tons, having an estimated value of $487,462.27; passengers carried, 70. It is impracticable to get complete and accurate commercial statistics of such shipments, because records are not generally kept, and it is believed that in this way considerable tonnage is lost to the Government records. The improvements thus far have given material aid to the lumber interests involved.

July 1, 1899, balance unexpended	$3,299.73
June 30, 1900, amount expended during fiscal year	748.10
July 1, 1900, balance unexpended	2,551.63
July 1, 1900, outstanding liabilities	1.50
July 1, 1900, balance available	2,550.13
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix E E 2.)

3. *Cumberland River, Tennessee and Kentucky*—(*a*) *Below Nashville* (*191 miles*).—Operations for the improvement of this section of the river date as far back as 1832. Congress made five appropriations for it prior to 1839, $20,000 of which was to be expended below Nashville, and the balance, $135,000, on the river generally.

A survey of the river was made in 1870, and the report of results is printed in the Annual Report of the Chief of Engineers for 1871, page 468 et seq.

The lower river is generally regarded as navigable for six months of each year by boats drawing not over 3 feet, and all the year by boats drawing 16 inches or less.

The original project for improvement, based on the survey of 1870, proposed the construction of deflecting dams, dredging, rock excavation, and the removal of logs, snags, etc., at an estimated cost of $248,821, afterwards increased in 1884 to $348,000.

The total amount appropriated (1871–1890) under the original scheme or open-channel project, up to the adoption of the new scheme or canalized-river project, was $305,000, which resulted in an improved channel at the most dangerous obstructions and in lengthening the season of navigation.

Part of expenditures under the above was applied to work at the mouth of the river in consequence of a provision made by Congress by act of September 19, 1890, for improving the mouth of the river, as recommended by a Board of Engineer Officers, by constructing a pile dike with crib superstructure to increase the depth of water over the shoals at the junction of the Cumberland and Ohio rivers. In 1893 a pile dike was constructed to protect the bank opposite the Kentucky mainland for a distance of about 3,150 feet, and the bank revetted with rock and brush. This work formed a part of the project of the Board, and the results obtained are that the channel has been improved and maintained and the banks protected from erosion.

A resurvey of the mouth of the river was made under the provisions of the act of June 3, 1896, and the results were printed in the Annual Report of the Chief of Engineers for 1897, page 2242.

A survey of the Cumberland River below Nashville was made under the provisions of act of August 11, 1888, to ascertain whether it is necessary to establish locks and dams thereon.

The existing project is based on the last of the above-named surveys and contemplates the extension of the lock and dam system of the upper river over a considerable portion of the river below Nashville by the construction of 7 locks and dams, commencing at or near Harpeth Shoal (Lock A) and ending at Big Eddy Shoal (Lock G); the locks to be 52 feet wide and 280 feet long, with lifts varying from 8½ to 11½ feet, and aggregating some 70 feet. The project also included the improvement of the Kentucky Chute at the mouth of the river according to the recommendation of the Board of Engineer Officers, June 16, 1888 (Annual Report of the Chief of Engineers for 1888, p. 1628), the necessary channel work below Lock G, and the removal of surface obstructions, snags, logs, etc., below Nashville. The total estimated cost of the entire improvement is $1,964,500 (Annual Report of the Chief of Engineers for 1890, pp. 2151–2161).

This project may be said to have been adopted by the act of July 13, 1892, appropriating $40,000 for continuing the improvement of the Cumberland River, including its mouth, and providing "that $10,000 of this sum, or so much thereof as may be necessary, shall be available for acquiring site and locating lock and dam near the mouth of Harpeth River, Tennessee."

Inasmuch as the shoals near the mouth of Harpeth River constitute the most formidable obstruction of the Cumberland below Nashville, it is proposed to press the work on Lock A and its accessories to completion at the earliest possible date. Appropriations aggregating $250,000 have been made for this work under the new or canalized-river project.

The expenditures to June 30, 1899, under this project amounted to $153,569.48.

The condition of the work at Lock A at the present time may be briefly stated as follows: The cofferdam around the lock site is completed and 9,082 cubic yards of lock masonry laid. The stone for finishing lock is quarried and piled on bank; 4,000 barrels cement stored; 1,623 cubic yards sand and 599 cubic yards gravel are ready for use in laying of masonry. Most of the stone for filling the dam, riprapping, and paving is on hand, being the refuse from quarry in getting out dimension stone. Bank behind land wall of lock is filled to the level of top of masonry. Part of anchor irons for lock gates are on hand. The channel of river was thoroughly cleared during the year from Nashville to the mouth.

The cost of maintenance of the river in its present condition by the removal of surface obstructions, logs, snags, etc., is about $5,000 per annum, and this amount can be profitably expended for such work during the fiscal year 1902.

The officer now in local charge presents a strong argument in his report, given in the proper appendix and to which attention is invited, wherein the necessity for completion of the lower river improvement so as to afford an outlet into the Ohio River is urgently set forth. It is desirable that this improvement shall be accomplished at the earliest possible date, and thereby afford an all-year navigation between the city of Nashville and the Ohio River, as well as an outlet to the reach of improved river above Nashville, so that the improvements already made there would become available to commerce.

The commerce of the Lower Cumberland during the calendar year 1899, so far as could be ascertained, aggregated 263,608 tons, having an estimated value of $4,771,049.

July 1, 1899, balance unexpended	$96,430.52
June 30, 1900, amount expended during fiscal year	72,820.80
July 1, 1900, balance unexpended	23,609.72
July 1, 1900, outstanding liabilities	6,567.68
July 1, 1900, balance available	17,042.04
Amount (estimated) required for completion of existing project	1,714,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	600,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(*b*) *Above Nashville* (*357 miles*).—Operations for the improvement of this river were commenced by the States of Kentucky and Tennessee as early as 1830. Congress made five appropriations for it as early as 1839, aggregating $155,000.

The river was surveyed in 1870 with a view to further improvement, and the report of the results is printed in the Annual Report of the Chief of Engineers for 1871, page 468 et seq. This survey separated the upper portion of the river into two divisions, the first division extending from the Great Falls to Burnside, Ky., and the second division from Burnside to Nashville.

The project for improvement based on the above, contemplated rock excavation and dam construction on the first division at a cost of $40,116, and dam construction, rock excavation, and rock and timber removal on the second division at a cost of $163,727. The construction of a canal or the canalization of the river on the first division is mentioned in the report as an effective means of improvement, but as too expensive, considering the interests involved.

Other examinations and surveys were made in 1874, 1879, and 1880, under which operations were conducted until the present project was adopted. The open-channel scheme of improvement, or old project, resulted in affording increased depths at the principal obstructions and in securing a longer period of safe navigation.

There was $346,000 expended on the old project as above indicated.

The existing project for the canalization of the Cumberland River above Nashville is based on reports of an examination and survey in 1882 and 1883 (Annual Report of the Chief of Engineers for 1884, p. 1662 et seq.) and on the acts of September 19, 1890, and July 13, 1892.

By act of September 19, 1890, Congress provided that of the general appropriation for improving Cumberland River above Nashville, $50,000 might be expended in commencing the improvement at Smith Shoals, and by acts of July 13, 1892, and August 18, 1894, it was provided that $10,000 of a like general appropriation might be used "in the improvement of the river above the town of Burnside."

This scheme of improvement comprehends the construction of 23 locks and dams below Burnside and 6 locks and dams at Smith Shoals, above Burnside; and it intends to provide a complete system of lockage from Nashville, Tenn., to Rock Castle River, so as to afford a channel depth of 6 feet, the locks to be 52 feet wide and 280 feet long, with lifts varying from 10 to 12 feet, at an estimated cost of $8,500,000 (see Annual Report of the Chief of Engineers for 1896, p. 1916). Of this amount $1,695,000 has been appropriated.

The amount expended to June 30, 1899, was $1,311,781.42.

During the fiscal year operations have been in progress at Locks 1, 6, and 7 under contract and at Lock 5 by hired labor.

The contract with McArthur Brothers Company for lock and abutment of Dam No. 6 was completed and closed March 31, 1900, and for lock and abutment of Dam No. 7, March 19, 1900.

The river and harbor act of March 3, 1899, provides for the "completion of unfinished Locks and Dams 1, 5, 6, and 7 or either of them." Proposals for the construction of lock approaches and abutment protection at Lock 1 were received, the lower one aggregating $96,342.63. These proposals were rejected as excessive and the work readvertised. Bids under the second advertisement, three in number, were opened August 28, 1899, and contract awarded to the lowest bidder, at $77,971.80. This contract was to have been completed by December 31, 1899, but an extension of time was granted to December 31, 1900.

At the close of the fiscal year the work done under this contract is as follows:

Earth excavation above the lock	cubic yards..	3,261
Rock excavation above the lock	do....	9,679
Cofferdam removed	linear feet..	65
Earth excavation at abutment	cubic yards..	50

The masonry of lock walls and abutments Nos. 1 and 5 are also completed; Lock No. 2 will require no dam abutment, and the dam abutments of Locks 3 and 4 are still to be provided.

With the completion of the operations now in progress at Locks 1 and 5, the work remaining to be done in order that the seven locks (1 to 7, inclusive) may be made operative is estimated to cost $898,740.15, as per the detailed report referred to in the accompanying appendix.

There is a balance of $17,035.39 applicable to Locks 21 and 22 that is expected to be applied in getting out stone for Lock 21.

Operations for clearing the river of surface obstructions and for repair of diverting dams, as required, were in progress from the beginning of the fiscal year until September 9, 1899, when work for the season was suspended.

The annual expenditure for these open-channel operations is estimated at $5,000.

The commerce of the Cumberland River above Nashville during the calendar year 1899, as near as could be ascertained, aggregated 294,763 tons, having an estimated value of $4,490,412.

July 1, 1899, balance unexpended		$383,218.58
June 30, 1900, amount expended during fiscal year		210,049.90
July 1, 1900, balance unexpended		173,168.68
July 1, 1900, outstanding liabilities	$2,013.56	
July 1, 1900, amount covered by uncompleted contracts	66,984.34	
		68,997.90
July 1, 1900, balance available		104,170.78
Amount (estimated) required for completion of existing project		6,805,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		600,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix E E 3.)

IMPROVEMENT OF TENNESSEE RIVER AND ITS TRIBUTARIES.

This district was in the charge of Maj. Dan C. Kingman, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

TENNESSEE RIVER SYSTEM.

The Tennessee River and its principal tributaries form a system of internal waterways capable of being navigated more than 1,350 miles by steamboats. In addition to this it is still further navigable by rafts and flatboats for a distance of more than 1,050 miles, thus making a system of navigable water of the United States 2,400 miles in extent.

The river is not navigable during the entire year, but the improvements which have already been made are sufficient to demonstrate that the main trunk of the river can be made navigable throughout the year, and that the useful season of navigation can be greatly lengthened on all the tributaries. The whole system, on account of the hard bottom of the streams and their stable banks, and from the fact that they are seldom obstructed by ice, is exceptionally susceptible of improvement.

Notwithstanding the many obstructions which still exist in the river and the difficulties and dangers of navigation, there were 64 different steamboats, of an aggregate tonnage of 8,553 tons, and 290 barges, of a carrying capacity of 75,538 tons, employed during the year 1899 upon the system. In addition to these a large amount of lumber was transported in rafts and a considerable amount of material was moved in flatboats, of which no record could be obtained. The statistics actually collected show that there were transported upon the river during that year more than 67,514 passengers, and nearly 985,199 tons of freight, valued at $14,550,376.30.

For the purpose of appropriation and administration the river system has been subdivided as follows:

1. Tennessee River—(a) Above Chattanooga, Tenn. (188 miles).—This section of the river extends from the junction of the French Broad and Holston rivers to Chattanooga. In its original condition it was obstructed by rock reefs, bowlders, gravel bars, and by snags brought down by freshets. The depth of water on the bars varied from 10 inches to 30 inches at low water, and the current was at some places as great as 6 miles an hour. The river was examined in 1830 by Col. S. H. Long, United States Topographical Engineers, and a project for its improvement was prepared. This project proposed to blast a channel through the reefs, reduce the gravel and sand bars, and to deepen the water on the bars by the construction of wing dams and training walls, thus contracting the waterway so as to secure a safe navigable channel 3 feet deep at average low water. No work, however, was done by the United States under this project until 1869, when an allotment of $35,000 was made for improving this portion of the river.

In 1871 another examination was made between Knoxville and Chattanooga, with the result of somewhat increasing the estimates of Colonel Long. Work was carried on under this project until 1893, and a partial improvement was effected at 29 of the 43 obstructions enumerated by Colonel Long in his report of 1830.

The river and harbor act of September 19, 1890, required that a careful and comprehensive survey should be made of this portion of the river and a new project submitted for its improvement. This survey was made under the direction of Col. Henry M. Robert, Corps of Engineers, by Capt. John Biddle, Corps of Engineers, and a report was submitted February 23, 1893, and received Congressional sanction in the river and harbor act of August 18, 1894.

The total amount expended to June 30, 1895, under the original project was $293,255.83.

Since the adoption of the present project, to June 30, 1899, $70,974.16 has been expended.

The second project is not a change or departure from the original project. It is intended to secure precisely the same results, and by similar means and methods, but the project is now based upon an accurate survey.

The work already done has resulted in greatly improving the low-water navigation of the river, and the season of navigation has been materially lengthened.

The commerce on the river has increased and the cost of water transportation has been reduced. The total value of freight carried on this portion of the river during the calendar year ending December 31, 1899, was $2,839,037.55.

During the past year such improvement as has been possible with the funds available has been carried on exclusively at McNutt Shoals, Baker Shoals, and Knoxville Shoals, the first three shoals in order from the head of the river downward.

At the beginning of the fiscal year stone was being quarried at the Baker Shoals quarry for use in the construction and repair of dams at Knoxville and Baker shoals.

Baker Shoals was a very serious obstruction to navigation, and some attempt had been made to improve it years ago by the construction of a half-moon-shaped dam, which forced the current at low water near to the left bank. The improvement was not a satisfactory one, as the fall was concentrated at the end of the dam, and as a bar tended to form where the water spread out, a short distance below the opening. The shoal itself was formed of bowlders and gravel.

For its improvement a training wall, 1,151 feet in length, was built across the shoal and connected and generally parallel to the left bank of the river, and a channel was dredged along the training wall of sufficient width and depth to conform to the conditions of the project. About 3,500 yards of gravel and bowlders were taken from the channel, and about 1,000 yards of stone removed from the old dam.

The training wall contained about 5,400 yards of stone, and about 1,600 yards was used in riprapping the right bank. The improvement is a satisfactory one. The channel maintains itself well, the slope of the water surface is uniform, and the velocity of the current is not great enough to interfere with navigation at any stage.

McNutt Shoals, a short distance above Baker Shoals, was formed by a number of detached rock reefs and points, which so obstructed the channel and made it so crooked and intricate that it could not be followed at low water. These reefs and points were removed by blasting, and the stone taken from them was used in protecting the bank and in constructing a training wall, 780 feet in length, from the left bank to confine the channel and regulate the slope.

About 3,000 cubic yards of rock was excavated and used for the purpose described. The improvement is a satisfactory and a permanent one.

At Knoxville Shoals some work was done in repairing and strengthening existing dams, and about 1,300 cubic yards of material was dredged from the channel.

During the year 4 deck barges, 20 feet by 100 feet, were built by hired labor for use in connection with the improvement, and one Osgood dipper dredge, of 1 cubic yard capacity, was built from allotments from the Tennessee, French Broad, and Clinch rivers.

The county bridge across the Tennessee River at Knoxville has been recently constructed by the Youngstown Bridge Company. After the bridge was finished the cofferdams surrounding the piers in the river were not removed, and formed a serious obstruction to navigation, and threatened to still further injure the river by the deposits which were collecting below them. Under the authority of the Secretary of War, these cofferdams were removed by the United States at the cost of the Youngstown Bridge Company.

Two thousand two hundred cubic yards of gravel and clay and more than 10,000 feet of sheet piling and other timber was removed by dredging and the use of derrick boats. The actual cost of this work was $348.19, which, as stated, was paid by the bridge company.

As no appropriation was made at the last session of Congress the funds available will not permit any work of improvement to be undertaken during the present year.

July 1, 1899, balance unexpended	$26,770.01
June 30, 1900, amount expended during fiscal year	24,058.84
July 1, 1900, balance unexpended	2,711.17
July 1, 1900, outstanding liabilities	134.46
July 1, 1900, balance available	2,576.71

Amount (estimated) required for completion of existing project	555,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(*b*) *Below Chattanooga, Tenn.* (*456 miles*).—The original condition of the river from Chattanooga to Browns Ferry was unfavorable to navigation, the channel being obstructed by rock reefs, bars, bowlders, and projecting rocky points, permitting the passage of vessels from six to nine months annually. From Browns Ferry to Florence it was navigable only at unusual high-water stages, owing to the obstructions known as Big and Little Muscle shoals. Navigation between Florence and Riverton, Ala., was limited to about six months annually, owing to the obstructions known as Colbert and Bee Tree shoals.

The existing project of improvement is as follows:

(1) By blasting and dredging to remove existing obstructions to navigation at Ross Towhead, in the mountain section, at Bridgeport and Guntersville, and elsewhere on the river.

(2) Building a canal 14.5 miles long, 70 to 120 feet wide, and 6 feet

deep, to permit navigation past the river obstruction known as Big Muscle Shoals, the canal to have nine locks, each 60 feet wide by 300 feet long, and to cross Shoal Creek by means of an aqueduct 900 feet long and 60 feet wide. Constructing a canal 1½ miles long to enable vessels to avoid the obstruction known as the Elk River Shoals. This canal to have two locks, one at each end.

(3) Constructing at Little Muscle Shoals a canal about 3 miles long and 6 feet deep, with two locks, each 60 feet wide by 300 feet long, and with 5 feet on the miter sills, at an estimated cost of $1,537,762.

(4) Constructing a canal 8 miles long, 150 feet wide, and 7 feet deep, past the Colbert and Bee Tree shoals obstructions, with one guard lock at the upper end and one lock with 25-foot lift at the lower end. These locks to be 80 feet wide and 350 feet long, and with 6 feet on the miter sills, at an estimated cost of $2,500,000.

(5) Protecting Livingston Point, Kentucky, from destruction by revetments of stone and brush carried well down the bank below the water surface, supplemented by pile and stone dikes. This work is necessary to the preservation of the harbor of Paducah, Ky.

(6) Making a survey of the uncharted portion of the Tennessee River, between Shellmound and the head of Browns Island, a short distance below Decatur.

(7) Improving the river below Riverton by dredging.

The total amount expended to June 30, 1899, was $4,650,057.94.

This expenditure had resulted in the completion of the Big Muscle Shoals and Elk River Shoals canals and their approaches at a cost of $3,181,726.50, and in the improvement of Little Muscle Shoals by excavation and the construction of wing dams, whereby its navigation was greatly improved; but as the results show that the requisite depth could not be obtained in this manner, the new project for a canal at Little Muscle Shoals was adopted October 29, 1890.

In like manner the Bee Tree and Colbert shoals were temporarily improved and the season of navigation over them materially lengthened by channel work, at a cost of $62,243.41. This was before the adoption of the present project for the lateral canal.

The masonry of the lift lock at Colbert Shoals has been completed, and the right of way for the canal has been purchased and paid for.

The appropriation of March 3, 1899, provided funds for the survey of that portion of the river which had not heretofore been mapped. This portion lies between Shellmound, a short distance above Bridgeport, Ala., and the head of Browns Island, a short distance below Decatur. The total length of this part of the river is 136 miles.

The field work has been completed and the charts are now being plotted. The final report will be ready before the next meeting of Congress. The cost of this work will be about $6,500.

The same appropriation required a survey and examination of that portion of the river known as the "Mountain section," immediately below Chattanooga, with a view to its improvement by locks and dams. This has been done, and a final report was submitted January 17, 1900, and published as House Doc. No. 461, Fifty-sixth Congress, first session. It is also herewith as Appendix F F 6.

This report proposes an improvement by means of a single lock and dam, designed to entirely overcome and do away with all obstructions to navigation through the Mountain section and to afford a low-water depth of not less than 5 feet to Chattanooga. The estimated cost of the improvement is $888,624, and the time required for its completion two years.

Authority was contained in the law making the appropriation for improving the Tennessee River between Chattanooga and Riverton to survey the French Broad River and the Clinch River in Tennessee. Allotments were made from the appropriation for this purpose.

The survey of the French Broad River has been completed, and a final report, with plans and estimates for its improvement, was submitted March 27, 1900, and published in House Doc. No. 616, Fifty-sixth Congress, first session. It is also herewith as Appendix F F 10. The cost of the survey was $3,200.

The field work of the Clinch River survey has been completed and the results plotted, and the final report is in course of preparation and will be submitted at an early date. The cost of the survey complete will be about $4,000.

At Colbert Shoals the principal work has been the care and protection of the embankments, the removal of the cofferdam across the entrance to the lock, and the excavation of the remaining rock and gravel at the entrance.

The lift lock is an excellent piece of masonry work, and has been constructed in the most thorough manner throughout and in exact accordance with the approved project. The length of the main walls of the lock is 571 feet each, and the length of the south entrance wall, which is a prolongation of the south wall, is 485 feet; the length of the north entrance wall is 185 feet, making the total length of wall 1,812 feet. The main lock walls are 37 feet high, and the entrance walls 32½ feet high; 35,445 cubic yards of masonry was required for the construction of these walls.

The work of quarrying and cutting stone for the construction of the guard lock has been in progress during the year, the work being done by hired labor. The stone is obtained from what is known as the Keller Quarry, near Sheffield, Ala. It is a fine-grained oölitic limestone of excellent quality and known durability. About 11,100 cubic yards of stone has been quarried, of which 6,764 yards has been scabbled for backing and 4,233 yards cut for face stone.

The work of improving the Tennessee River below Riverton by dredging has been carried on with the new plant recently purchased by the United States. This plant consists of a Bucyrus dipper dredge of 4 yards capacity and three 100-yard side-dumping scows.

Work has been done at Rockport Bar, and is now in progress at Beech Creek Shoal. The plant is working in a satisfactory manner and the result is encouraging and strengthens the belief that all necessary improvement on this portion of the river can be cheaply and satisfactorily effected by means of dredging.

The revetment at Livingston Point on the Ohio side has been repaired as required, and the revetment on the head of Tennessee Island has been added to and strengthened. About 600 tons of riprap stone was used on Livingston Point, and about 2,000 tons in strengthening and repairing the revetment on Tennessee Island.

The United States snagging barge belonging to the district passed over the river down and back in the fall of 1899, and removed all snags and other obstructions visible at that time. The channel was left in excellent condition.

July 1, 1899, balance unexpended	$274,468.09
June 30, 1900, amount expended during fiscal year	169,687.10
July 1, 1900, balance unexpended	104,780.99
July 1, 1900, outstanding liabilities	14,214.47
July 1, 1900, balance available	90,566.52
Amount (estimated) required for completion of existing project	5,127,939.81
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	600,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix F F 1.)

2. Operating and care of Muscle Shoals Canal, Tennessee River.—This canal has been maintained in a state of efficiency and readiness for use throughout the entire year. The number of commercial steamboats and barges that used it during the calendar year ending December 31, 1899, was 541, and the freight carried was 14,319 tons, worth $295,003; the number of lockages was 2,153. This is a material increase over the business done upon the canal in the preceding year.

The canal is 16 miles in length and has 11 locks. It has a railroad nearly 15 miles in length and a large number of buildings for the occupancy of the employees of the United States and for other purposes.

The total cost of operating and care for the fiscal year ending June 30, 1900, was $63,355.95.

In 1895 authority was given for the construction of a dry dock near Lock No. 6 on the Muscle Shoals Canal for the purpose of providing a place for the repair of the floating plant belonging to the improvement works of the Tennessee River, one-half of the cost of the same to be charged to operating and care of Muscle Shoals Canal and one-half to the general improvement of the river. The dry dock was completed in February, 1897, and since that time has been constantly used in the repair of the Government plant. It is the only dock within a radius of 250 miles, and its use to a limited extent for the repair of private boats would doubtless be of great service to the commercial interests. There is no existing law, however, permitting it to be so used, and I recommend that Congress specially provide that the said dry dock may be used for the examination and repair of vessels for private parties, under such regulations and for such compensation as may from time to time be fixed by the Secretary of War.

(See Appendix F F 2.)

3. French Broad and Little Pigeon rivers, Tennessee.—(*a*) *French Broad River.*—This river is one of the largest tributaries of the Tennessee. It rises in North Carolina, flows generally in a westerly direction, and finally unites with the Holston River, in the State of Tennessee, to form the Tennessee River.

The upper portion of the river in Tennessee is hardly susceptible of improvement. Its fall is excessive and its discharge not great; but after uniting with the Nolichucky River its axial slope diminishes and its volume of water is sufficient to make it useful for the purposes of navigation. The mouth of the Nolichucky, about 70 miles above the junction with the Holston, is therefore assumed as the upper limit of proposed improvement.

In its original condition this portion of the river was obstructed by rock reefs, sand and gravel bars, and by bowlders, snags, and overhanging trees, and numerous islands in the river divided the water and diminished the depth in the navigable channels.

The project for its improvement is based upon a reconnaissance made about thirty years ago. It has for its object the removal of surface obstructions, the excavation of channels through reefs and bars, and the concentration and regulation of its flow by means of wing dams and training walls, so as to secure a channel depth of 2½ feet at ordinary low water as far up as the town of Leadvale, a short distance below the mouth of the Nolichucky.

The amount expended to June 30, 1899, was $74,622.96. This expenditure resulted in the improvement of navigation below Dandridge, 50 miles from the mouth, by deepening and clearing the channel, removing natural and artificial obstructions, constructing wing dams, sills, and training walls, and revetting the bank where necessary.

The work, when properly planned, has been remarkably successful, and at several points, such as Hanging Rock Shoals, Seven Island Shoals and Bryant Shoals, places which were formerly insurmountable, boats can now pass at all stages without difficulty. But the work has been carried on at a disadvantage in consequence of the lack of a thorough survey and a detailed and comprehensive plan of improvement.

The act of Congress approved March 3, 1899, appropriated $35,000 for improving the Tennessee River between Chattanooga and Riverton, and provided that so much as should be necessary might be used for a survey of the French Broad River. An allotment of $3,600 was accordingly made from this appropriation for the survey. The survey has been completed; the work has been plotted, and the report, with a detailed plan and estimate for a systematic improvement of the river from its mouth to the mouth of the Nolichucky, was submitted March 27, 1900, and is printed in House Doc. No. 616, Fifty-sixth Congress, first session; it is also herewith as Appendix F F 10.

The total value of freight carried on the French Broad River during the calendar year of 1899 was $779,705.10, or more than ten times the total amount expended on the river since the improvement was begun by the United States in 1880.

For continuing the improvement $5,000 was appropriated in the last river and harbor act. From this sum it was necessary to allot $2,000 to be expended in connection with other allotments for the construction of a suitable dredge for use upon this river and elsewhere. The dredge has been completed and is ready for use.

The balance available is too small to permit any extensive work to be undertaken upon the river. It will be used as may be necessary for the repair of existing works and for dredging at such points as may most require it.

(*b*) *Little Pigeon River.*—This river is formed by the junction of its east fork and south fork at Sevierville, Tenn., and flows in a northwesterly direction for about 5 miles, where it empties into the French Broad about 32 miles above Knoxville.

In its original condition it was obstructed by rock and gravel shoals and by rapids.

The project provides for the removal of the bar near the mouth of the river and the removal of the shoal below Catlettsburg so as to permit light-draft steamers to reach that place.

A channel 30 inches deep at low water was dredged through the bar at the mouth of the Little Pigeon; 1,505 cubic yards of loose rock and small bowlders was removed, and about two-thirds of this was used in riprapping the head of McCroskeys Island, which was rapidly washing away, and the remainder was used for repairing the dam across the island chute.

It is impracticable to separate the freight carried on the Little Pigeon River from that carried on the French Broad, as the same boats are engaged in the trade, and the Little Pigeon practically amounts to an additional landing on the French Broad.

Owing to the great slope of the Little Pigeon River it is subject to sudden and violent freshets, and these bring down coarse gravel and bowlders, which tend to re-form the two bars which now obstruct the navigable portion of it. Redredging of these bars will be necessary from time to time, and the improvement can never be considered as completed.

July 1, 1899, balance unexpended		$5,377.04
June 30, 1900, amount expended during fiscal year		1,968.58
July 1, 1900, balance unexpended		3,408.46
July 1, 1900, outstanding liabilities		101.56
July 1, 1900, balance available		3,306.90
Amount (estimated) required for completion of existing project		80,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$20,000.00	
For maintenance of improvement	2,000.00	
		22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix F F 3.)

4. Clinch River, Tennessee.—This river rises in the Cumberland Mountains in Virginia, and after following a southwesterly course empties into the Tennessee River at Kingston, 104 miles above Chattanooga. About 230 miles of the river lies in the State of Tennessee.

In its original condition the channel was obstructed by rock reefs, sand and gravel bars, bowlders, snags, and overhanging trees.

The present project provides for channel excavations, removing surface obstructions, and the construction of wing dams and training walls, so as to secure a navigable channel 2 feet in depth at ordinary low water from the mouth of the river to Clinton, about 70 miles, and of 1½ feet in depth from Clinton to Haynes (or Walkers) Ferry, about 75 miles. From Haynes Ferry to Osborne Ford, in Virginia, a distance of 120 miles, it is proposed simply to remove the loose rock and bowlders, reduce the rock ledges, remove snags, overhanging trees, and similar obstructions, so as to assist raft and flatboat navigation at the stages at which the river is ordinarily used.

The amount expended to June 30, 1899, was $40,311.17, which resulted in reducing many of the reefs, removing obstructions from the channel, building several wing dams and training walls, whereby the channel was so far improved as to enable the river to be used at stages 2 to 3 feet lower than before the improvement was begun.

The act of Congress approved March 3, 1899, made an appropriation for improving the Tennessee River between Chattanooga and Riverton of $35,000, and provided that so much of this sum as should be necessary might be used in a survey of the Clinch River, and an allotment of $4,800 was made for this purpose to enable a survey to be made from Haynes Ferry to the mouth.

The field work of the survey was begun on June 1, 1899, and completed July 7, the actual length of the river surveyed being 136 miles. The office work of reducing and mapping the field notes was begun on February 1, 1900, and completed May 1 of the same year. The work is represented on 33 charts, 2 feet by 3 feet inside the border, and by 2 index maps of the same size. The scale of the charts is 1 inch to 400 feet, and of the index maps 1 inch to 1 mile.

The cost of the survey and the preparation of the charts, tracings, index sheets, and continuous profile was $3,914.26, or at the rate of about $28.75 per mile. This amount was charged, as the law required, to the appropriation for "Improving Tennessee River, between Chattanooga and Riverton." A full report of this survey, together with the plans and estimates for the improvement of the river, will be submitted before the meeting of Congress in December, 1900.

The river and harbor act above referred to appropriated $8,500 for improving Clinch River, Tennessee, completing the improvement. This amount is manifestly insufficient for the purpose. The estimate was based upon preliminary examinations made many years ago. The survey will doubtless furnish the means of determining with accuracy the cost of the carrying out of the proposed work.

The appropriations have been so small and irregular for the improvement of this river that very little plant necessary for the work has been accumulated.

An allotment of $3,000 was made from the present appropriation to be used in connection with other allotments from the appropriations for the Tennessee River above Chattanooga and the French Broad and Little Pigeon rivers, for the purchase of a suitable dredge and dump scows. The dredge was built by contract by the Osgood Dredge Company, of Albany, N. Y. It is now ready for use and will prove a very useful addition to the plant.

About $3,000 of the appropriation was also applied to removing snags, bowlders, leaning trees, and other obstructions, so as to improve the navigation of the river from Osborne Ford to the mouth for stages at which it is now used, and to lengthen, as far as may be, the season of navigation.

A party was organized for this work, and began work at Osborne Ford on August 4, 1899, and worked downward over the river to its mouth at Kingston, Tenn., arriving there October 31, 1899. This party removed or reduced a very great number of minor obstructions to navigation. Work of this kind is much appreciated, and it is always of immediate service to navigation.

The balance of the funds available, except the small amount which may be necessary for the care of the plant, will be reserved until the results of the survey are known and until the pleasure of Congress in regard to further improvement has been indicated.

July 1, 1899, balance unexpended	$9,688.83
June 30, 1900, amount expended during fiscal year	5,666.61
July 1, 1900, balance unexpended	4,022.22
July 1, 1900, outstanding liabilities	28.84
July 1, 1900, balance available	3,993.38
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix F F 4.)

5. *Elk River, Tennessee and Alabama.*—This is a new work. Elk River rises on the western slope of the Cumberland Mountains in the south central portion of Tennessee, flows in a southwesterly direction, and finally empties into the Tennessee River about 30 miles above Florence, Ala.

Fayetteville, Tenn., is regarded as the head of possible navigation. Above this the river is too small and the fall too great to admit of improvement. About 56 miles of the navigable portion lies in Tennessee and 34 miles in Alabama.

In its original condition the river was obstructed by low bridges, milldams, fish-trap dams, rock reefs, bowlders, snags, and overhanging trees. The present project for its improvement provides for the removal of surface obstructions below the point where it is crossed by the Louisville and Nashville Railroad, 34 miles above the mouth. There are no milldams below this point. The project also contemplates cutting through the rock reef at the mouth of the river, so as to permit the easy entrance to it from the Tennessee River.

The act of Congress approved May 4, 1898, required a survey to be made of Elk River in Tennessee and Alabama. This survey has been completed, and a report, dated June 10, 1899, has been submitted by the local officer. A plan and estimate for improvement accompanied the report, which was transmitted to Congress and printed in House Doc. No. 87, Fifty-sixth Congress, first session. It is also submitted herewith as Appendix F F 15.

The improvement recommended by the local officer is by means of locks and dams to secure a 4-foot navigation at low water from the Tennessee River to Fayetteville, Tenn., a distance of about 90 miles. The estimated cost of this improvement is $882,854.61. Congress has not yet taken action upon this plan and estimate.

The act of March 3, 1899, appropriated $4,000 for removing channel obstructions and cutting overhanging trees, etc., on the lower 35 miles of the river, and also for cutting through the reef at its mouth. This work has been done and will permit navigation during the higher stages of the river.

No appropriation is recommended pending Congressional action on the project submitted June 10, 1899.

July 1, 1899, balance unexpended	$4,000.00
June 30, 1900, amount expended during fiscal year	3,840.23
July 1, 1900, balance unexpended	159.77
July 1, 1900, outstanding liabilities	143.26
July 1, 1900, balance available	16.51

(See Appendix F F 5.)

EXAMINATIONS AND SURVEYS REQUIRED BY THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. Dan C. Kingman, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers:

1. *Survey of Tennessee River at the "Suck" or mountain section, below Chattanooga, Tenn.*—Major Kingman submitted report January 17, 1900, with plan for improvement at an estimated cost of $888,624, and in forwarding the report the division engineer stated that, for reasons given, the plan and estimate seem reasonable. The report was transmitted to Congress and printed in House Doc. No. 461, Fifty-sixth Congress, first session. (See also Appendix F F 6.)

2. *Preliminary examination of Tennessee River at Moccasin Bend, below Chattanooga, Tenn., for construction of canal.*—Major Kingman submitted report November 29, 1899. In his opinion the locality is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 168, Fifty-sixth Congress, first session. (See also Appendix F F 7.)

3. *Survey of Tennessee River between Bridgeport and Decatur, Ala.*—Major Kingman submitted preliminary report March 27, 1900, and states that in his opinion, concurred in by the division engineer, the locality is worthy of improvement by the General Government. Final report is in preparation and if possible will be submitted in time for transmission to Congress at its next session. The preliminary report was transmitted to Congress and printed in House Doc. No. 577, Fifty-sixth Congress, first session. (See also Appendix F F 8.)

4. *Preliminary examination and survey of Hiwassee River, Tennessee, from its mouth to the mouth of the Ocoee.*—Major Kingman submitted reports dated May 20, 1899, and March 27, 1900, respectively, the latter being a preliminary report on survey. In the opinion of Major Kingman the locality is worthy of improvement by the General Government, but the division engineer, in forwarding the report on survey, states that this preliminary report indicates that the Hiwassee is worthy of improvement, but this question can not be determined until after the completion of the final report. The reports were transmitted to Congress and printed in House Doc. No. 593, Fifty-sixth Congress, first session. (See also Appendix F F 9.)

5. *Survey of French Broad River, Tennessee.*—Major Kingman submitted report March 27, 1900, with plan for improvement at an estimated cost of $278,052.50. He considers the river worthy of improvement by the General Government and his views are concurred in by the division engineer. The report was transmitted to Congress and

printed in House Doc. No. 616, Fifty-sixth Congress, first session. (See also Appendix F F 10.)

6. *Preliminary examination and survey of Holston River, Tennessee.*—Major Kingman submitted reports dated May 22, 1899, and March 28, 1900, respectively, the latter being a preliminary report on survey. Final report is in preparation and if possible will be submitted in time for transmission to Congress at its next session. The reports were transmitted to Congress and printed in House Doc. No. 617, Fifty-sixth Congress, first session. (See also Appendix F F 11.)

7. *Survey of Clinch River, Tennessee.*—Major Kingman submitted preliminary report March 26, 1900. The locality is considered worthy of improvement by the General Government and final report on the subject will be submitted for transmission to Congress at its next session. The preliminary report was transmitted to Congress and printed in House Doc. No. 570, Fifty-sixth Congress, first session. (See also Appendix F F 12.)

8. *Preliminary examination of Powells River, Virginia and Tennessee.*—Major Kingman submitted report August 28, 1899, in which he states that the cost of a survey would be not less than $4,000, and in his opinion the expenditure of this amount in removal of bowlders, snags, and channel obstructions from the stream would be of greater value to the commercial interests involved, and is justifiable; also that no improvement other than this should be attempted at the present time. His views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 58, Fifth-sixth Congress, first session. (See also Appendix F F 13.)

9. *Preliminary examination of Richland River, Tennessee.*—Major Kingman submitted report August 15, 1899. It is his opinion, concurred in by the division engineer and by me, that the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 51, Fifty-sixth Congress, first session. (See also Appendix F F 14.)

Major Kingman was also charged with the duty of making survey of the following localities, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Tennessee River between Chattanooga, Tenn., and Riverton, Ala.*
2. *Little Tennessee River, Tennessee, from its mouth to the slate quarries on Abrams Creek.*

SURVEY OF ELK RIVER, TENNESSEE AND ALABAMA, MADE IN COMPLIANCE WITH ACT OF CONGRESS APPROVED MAY 4, 1898.

Final report on survey of *Elk River, Tennessee and Alabama, with a view to making it navigable for light-draft steamers*, was submitted by Major Kingman June 10, 1899, with plan for improvement at an estimated cost of $882,854.61. The report was transmitted to Congress and printed in House Doc. No. 87, Fifty-sixth Congress, first session. (See also Appendix F F 15.)

IMPROVEMENT OF OHIO RIVER.

This district was in the charge of Maj. Wm. H. Bixby, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Ohio River.*—The Ohio River from Pittsburg, Pa., to its mouth

in the Mississippi, near Cairo, Ill., has a length of about 1,000 miles. Its total drainage area is about 210,000 square miles. The total population of the cities and towns situated immediately upon the banks of the Ohio and its principal tributaries is, in round numbers, 1,800,000 (Census of 1890).

Original condition.—The first work to improve the navigation of the river was done in 1825. At that time the river was obstructed throughout its entire length by snags, rocks, and gravel and sand bars, and navigation at low stages was exceedingly difficult and dangerous, even for boats of only 1 or 2 feet draft.

Project.—The work on the Ohio River has been carried on in pursuance of a general plan which has been followed ever since the work was first begun in 1825.

In general terms, the design of the work proposed and approved is to aid navigation by increasing the low-water depth in the channel, so as ultimately to secure a minimum channel depth of 6 feet at low water all the year round from Pittsburg to the mouth of the river, 967 miles. This is to be accomplished by low fixed dams at islands, confining the water to a single channel; by dikes where shallow bars exist; by dredging; by the removal of rocks, snags, and other obstructions, and by the further addition in recent years of movable dams in the upper river down as far as Marietta, the construction of which is provided for by special appropriations separate from those for the general improvement, the latter being of course still necessary, although to a lessened extent. From the nature and extent of this work final estimates of cost were practically impossible.

The first of the movable dams is at Davis Island, 4½ miles below Pittsburg, and has been in successful operation since 1885. Dams Nos. 2, 3, 4, 5, and 6, from Davis Island to below Beaver River, Dam No. 13, below Wheeling, and Dam No. 18, below Marietta, are under construction. Reports on surveys of the past year have given estimates for the extension of the system to Dam No. 39, below Lawrenceburg, Ind.

The snagging work done and the construction and operation of movable dams are reported separately below, being covered by special appropriations. The rest of the work, namely, the surveys, fixed dams and dikes, dredging, bank protection, etc., constituting what is known as the general improvement of the river, where of special importance, are covered by subprojects, as follows:

Mouth of Licking Bar, opposite Cincinnati, under project approved April 1, 1899, for removal of bar to 200 feet width and 4 feet depth. Unexpended balance July 1, 1899, $78,000.

Mound City Bar, under projects of April 1, 1899, and May 4, 1900, for dikes and removal of bar to 300 feet width and 6 feet depth. Unexpended balance July 1, 1899, $75,976.10.

Lawrenceburg (Ind.) embankment repair, under provisions of act of March 3, 1899. Unexpended balance July 1, 1899, $15,017.23.

Shawneetown (Ill.) embankment repair, under provisions of acts of June 30, 1898, and March 3, 1899. Unexpended balance July 1, 1899, $32,607.45.

Evansville (Ind.) bank protection, under projects of 1896 and 1897. Unexpended balance July 1, 1899, $3,897.64.

Evansville (Ind.) dikes and dredging, under projects of 1895 and 1896. Unexpended balance July 1, 1899, $4,258.

Evansville (Ind.) harbor dredging, under provisions of act of March 3, 1899. Unexpended balance July 1, 1899, $20,000.

Madison (Ind.) harbor dredging and survey, under provisions of act of March 3, 1899. Unexpected balance July 1, 1899, $20,002.84.

Golconda (Ill.) harbor dredging, under projects of 1899. Unexpended balance July 1, 1899, $10,062.70.

Brooklyn (Ill.) harbor dredging, under projects of 1899. Unexpended balance July 1, 1899, $10,307.18.

Surveys.—Marietta to mouth of Big Miami, to determine cost of obtaining 6 feet navigation by movable dams, etc., under provisions of act of March 3, 1899. Unexpended balance July 1, 1899, $34,662.23. The emergency river and harbor act approved June 6, 1900, provides for continuing and completing this survey out of the general improvement funds.

Minor surveys, with reports, under provisions of act of March 3, 1899, at New Liberty, Ill., $1,000; at Paducah, Ky., $1,000.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $5,880,242.40.

The work accomplished up to that date has been of great benefit to navigation, but at many localities good results can be obtained only by a large expenditure, and the small amount available yearly for the whole river prevents much desirable work of improvement.

The work done during the year is as follows:

Dredging to small extent by the dredging plants at each of 16 bars between Cincinnati and Cairo.

Survey, Marietta, Ohio, to mouth of Big Miami River.—Work was carried on vigorously in the field all summer and in the office all the winter. Report, dated April 17, 1900, with estimates as to cost of the improvement, was transmitted to Congress and printed in House Doc. No. 648, Fifty-sixth Congress, first session; it is also submitted herewith as Appendix G G 8.

Lawrenceburg embankment.—Contract work was continued through the year. Work was practically ended on June 30, 1900.

Shawneetown embankment.—Contract was continued through the year, and the most important part of the same was practically finished.

Operations of United States dredges.—This plant was employed at Madison, Ind., and Mound City, Ill., and removed 91,095 cubic yards of material; at 8 other points, removed 52,896 cubic yards; snags removed, 35. Repairs of dredges were in progress from April 2 to June 30, 1900.

Hired dredging plants.—Two plants hired under contract were employed at Madison, Ind., and at Golconda, Brooklyn, and Mound City, Ill., and removed 39,523 cubic yards of material; at 10 other points, removed 30,905 cubic yards. Contracts were entered into in June for the hire of two dredging plants during the present season.

Harbor lines.—The principal field work was that of several special surveys of encroachments at Cincinnati and many other places along the river over its entire length, which required notices to the offenders. Notices were issued in many cases through the master of the United States snag boat. Office work in the completion and issue of maps and other data was continued through the year.

Results.—The result of improvement so far has been to enable lig[illegible]s, draft boats to run all through the low-water season, where they [illegible]rch, often stopped in former years for 3 or 4 months per year. The work of the past year was specially effective in this respect, and prevented a two-months' suspension of navigation above Cincinnati as well as below Louisville. The present extreme low-water depths of the Ohio River are, 6 feet above Davis Island Dam, 1.5 feet thence to Marietta, and 2 feet from thence to its mouth.

Commerce.—The total amount of freight transported during the calendar year was 13,529,742 tons; passengers, 3,612,985. The coal-boat traffic is constantly increasing, both as to total quantity of coal and as to the size of boats and the number of boats per tow.

No new lines of transportation have been established that would materially affect the aggregate commerce of the river.

During the season of 1899 navigation was suspended by low water for about 4 months in the summer of 1899 and by ice for a few days in January and February, 1900.

July 1, 1899, balance unexpended		$512,799.64
June 30, 1900, amount expended during fiscal year		115,626.41
July 1, 1900, balance unexpended		397,173.23
July 1, 1900, outstanding liabilities	$21,806.16	
July 1, 1900, amount covered by uncompleted contracts	7,725.96	
		29,532.12
July 1, 1900, balance available		367,641.11
Amount (estimated) required for completion of existing project		Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix G G 1.)

2. *Operating snag boat on the Ohio River.*—The condition of the channel way of the Ohio, the necessity for continuous snag-boat work, and the benefits accruing therefrom to river commerce are plainly shown by the yearly reports of obstructions removed, which obstructions, if permitted to remain, would make navigation highly dangerous at ordinary stages and hazardous at any time.

The project for removing obstructions by a properly equipped snag boat was put in operation in 1876, the boat having been completed at a cost of $125,125.24, and the expense of operating having been borne by appropriations for improving the Ohio River until 1890. The river and harbor act of September 19, 1890, provided $25,000 yearly for this purpose, and the act of June 3, 1896, increased the yearly appropriation to $50,000.

The amount expended on this work up to the close of the fiscal year ending June 30, 1899, was $234,341.34.

As far as practicable, removal of obstructions is carried on whenever permitted by the stage of water and the absence of dangerous ice. The work of the snag boat, in connection with the occasional hire of other boats and the sending out of small parties when the snag boat is not available, maintains a channel as nearly unobstructed as possible, a large and important part of the work being the removal of wrecked coal barges as soon as practicable after the limit permitted by law.

In this way during the year the snagging parties went over the entire length (1,000 miles) of river at least once and removed 92 wrecks, 1,522 snags, and 6,276 cubic yards of rock.

The amount expended during the year was $37,079.05.

(See Appendix G G 2.)

3. *Operating and care of Davis Island Dam, Ohio River, near Pittsburg, Pa.*—This dam is the first of the series for the slack-water improvement of the upper portion of the river. It has been in successful operation since 1885, and has proved to be of great benefit to commerce in general, and especially to coal interests, by allowing the harborage of coal at Pittsburg in large quantities while awaiting stages of water suitable to the passage of the boats down the river to its mouth.

The amount expended up to June 30, 1899, in operating this dam and keeping it in repair was $217,292.45.

During the year the dam was raised three times and lowered three times.

Some repairs were made to the wickets of the dam, and more extensive repairs are to be made when dredging in the harbor above is finished.

Other repairs of a minor character were made. The bear-trap dam, built in 1889, is in need of radical repair to enable its ready operation.

Navigation was not interfered with by any of these structures.

The amount expended during the year was $15,630.64.

(See Appendix G G 3.)

4. *Movable dams, Ohio River.*—For 150 miles or more below Pittsburg the narrow channel of the Ohio River is so greatly obstructed by bars and shoals that navigation for ordinary vessels is much interrupted and for the numerous coal fleets of this section is only possible during flood stages. The movable dam at Davis Island (completed in 1885) has greatly relieved these conditions near Pittsburg, and it is evident that the only method of securing the desired 6-foot navigation the year around is by a continuation of this system.

The construction of Dams Nos. 2, 3, 4, and 5 was provided for by the river and harbor act of June 3, 1896, which appropriated funds for the purchase of the sites "in accordance with the project submitted February 3, 1896," by which project (Annual Report of the Chief of Engineers for 1896, p. 2120) the estimated cost of these four dams was placed at $750,000 each, making a total estimated cost of $3,000,000 for the four. Further provision was made in the acts of June 3, 1896, and June 4, 1897, which authorized contracts to be let for so much of the work on Dams Nos. 2, 3, 4, and 5 as could be done within a $2,000,000 limit, which was $1,000,000 less than the total estimated cost. The $2,000,000 has now been entirely appropriated, leaving still $1,000,000 more necessary to provide for the completion of the work.

A special project for Lock No. 2 was approved by the Secretary of War July 28, 1897. A modification of the lock floor proposed in this project was approved September 20, 1897. Subsequently, as it appeared that Congress by its action intended that continuing contracts covering all these works should be arranged for immediately, the specifications were ordered to be amended so as to include Locks Nos. 3, 4, and 5. Contracts were accordingly made in December, 1897, for all four locks, and work on Nos. 2 and 4 was begun in April, 1898, on No. 3 in March, 1899, and on No. 5 in April, 1899.

At No. 2 the lock construction under contract was completed May 31, 1900. Preparations were then made for the construction of the navigable pass.

At No. 3 commencement of work was much delayed by difficulties in acquiring title to the land. Lock construction under contract has been continued through the year, and is about one-fifth done. Preparations were made for the removal of old dikes in the way of new contract work.

At No. 4 the lock construction under contract has been continued through the year and is about three-quarters done.

At No. 5 commencement of work was much delayed by difficulties in acquiring title to the land. Lock construction under contract has been continued through the year and is about one-quarter done.

The amount expended on Dams Nos. 2, 3, 4, and 5 up to the close of the fiscal year ending June 30, 1899, was $199,432.79.

The construction of Dam No. 6, now building, was ordered by the river and harbor act of September 19, 1890, without previous report or estimate. It is assumed that Congress adopted the report of a Board of Engineers dated November 27, 1888, in which the cost was estimated at $900,000. The $900,000 has all been appropriated. The special projects so far approved are as follows: Preliminary, September 27, 1890; lock, June 16, 1892; Chanoine dam across navigable pass, June 10, 1896, commenced under contract but finished partly by hired labor and partly by new contracts, by reason of the failure of the first contractor. A special project for closing the gap between the navigable pass and the left bank by three bear-trap dams was approved July 27, 1897, but work at that time was not practicable. A modified project for the same was submitted June 9, 1898, providing for two spans of bear-trap and one of A-frame dam, which was submitted to a Board of Engineers for consideration, and, upon the Board's suggestion, was approved August 1, 1898, allowing $12,000 for the extra cost of the A-frame section. The lock and navigable pass have been built. The contract work on the weirs, piers, and abutment, entered into May 10, 1899, has been continued through the year and is about one-third done. The lock gate, maneuvering apparatus (including power-house machinery, boats, etc.), the employees' quarters, storehouses, and grading, paving, riprapping, etc., of banks remain still to be provided for by further appropriations.

The amount expended on Dam No. 6 up to the close of the fiscal year ending June 30, 1899, was $646,806.42.

The river and harbor act of March 3, 1899, made appropriations for the commencement of work on Dam No. 13, near Wheeling, and Dam No. 18, near Marietta, in accordance with the project of the report of December 28, 1898, for 6 feet of water the year round, by movable dams from Pittsburg to Marietta, at a cost of $850,000 per dam. It also provided that continuing contracts may be entered into for the completion of such work at Dams Nos. 13 and 18, not to exceed in the aggregate $850,000 at each place. So far $570,000 has been so appropriated. Surveys have been completed, and title to the lands is being acquired.

Commercial statistics are appended to the report for improving Ohio River.

CONSOLIDATED.

July 1, 1899, balance unexpended		$1,578,760.79
Amount appropriated by sundry civil act approved June 6, 1900		1,065,000.00
		2,643,760.79
June 30, 1900, amount expended during fiscal year		466,539.43
July 1, 1900, balance unexpended		2,177,221.36
July 1, 1900, outstanding liabilities	$6,546.40	
July 1, 1900, amount covered by uncompleted contracts	504,446.97	
		510,993.37
July 1, 1900, balance available		1,666,227.99
Amount (estimated) required for completion of existing project		2,260,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		[1]525,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

DAMS NOS. 2, 3, 4, AND 5.

July 1, 1899, balance unexpended		$1,245,900.50
Amount appropriated by sundry civil act approved June 6, 1900		595,000.00
		1,840,900.50
June 30, 1900, amount expended during fiscal year		372,425.20
July 1, 1900, balance unexpended		1,468,475.30
July 1, 1900, outstanding liabilities	$2,335.78	
July 1, 1900, amount covered by uncompleted contracts	365,467.93	
		367,803.71
July 1, 1900, balance available		1,100,671.59
Amount (estimated) required for completion of existing project		980,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

DAM NO. 6.

July 1, 1899, balance unexpended		$232,860.29
June 30, 1900, amount expended during fiscal year		90,076.08
July 1, 1900, balance unexpended		142,784.21
July 1, 1900, outstanding liabilities	$3,805.17	
July 1, 1900, amount covered by uncompleted contracts	138,979.04	
		142,784.21
Amount (estimated) required for completion of existing project		150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

DAMS NOS. 13 AND 18.

July 1, 1899, balance unexpended	$100,000.00
Amount appropriated by sundry civil act approved June 6, 1900	470,000.00
	570,000.00
June 30, 1900, amount expended during fiscal year	4,038.15
July 1, 1900, balance unexpended	565,961.85
July 1, 1900, outstanding liabilities	405.45
July 1, 1900, balance available	565,556.40
Amount (estimated) required for completion of existing project	1,130,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G G 4.)

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[1] Of this amount $325,000 is for continuing construction of Dams Nos. 2–6, and $200,000 for work on Dams Nos. 13 and 18 under continuing contract.

5. *Survey of Licking River, Kentucky.*—The river and harbor act of March 3, 1899, appropriated $10,000 for survey of Licking River, Kentucky, from its mouth, opposite Cincinnati, Ohio, to Falmouth, Pendleton County, Ky., and for estimate of the cost of a lock and dam at or near Three-mile Riffle, about 3 miles from its mouth.

Final report dated April 17, 1900, was transmitted to Congress and printed in House Doc. No. 645, Fifty-sixth Congress, first session. It is also submitted herewith as a part of Appendix G G 5. Detailed maps are being completed for future reference and use.

July 1, 1899, balance unexpended	$10,000.00
June 30, 1900, amount expended during fiscal year	4,423.14
July 1, 1900, balance unexpended	5,576.86
July 1, 1900, outstanding liabilities	175.00
July 1, 1900, balance available	5,401.86

(See Appendix G G 5.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. Wm. H. Bixby, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers:

1. *Preliminary examination of Ohio River, from Mound City to Cairo, Ill., with a view to protection of banks and levees on the Illinois side.*—Major Bixby submitted report October 3, 1899. It is his opinion, concurred in by the division engineer and by me, that the locality is not worthy of improvement by the General Government in the interests of navigation. The report was transmitted to Congress and printed in House Doc. No. 137, Fifty-sixth Congress, first session. (See also Appendix G G 6.)

2. *Preliminary examination and survey of Ohio River at or near New Liberty, Ill., with a view to protection of the banks and to prevent the river from cutting into a slough and chain of lakes at said point.*—Major Bixby submitted reports dated September 30, 1899, and April 13, 1900, respectively. A plan for improvement at an estimated cost of $730,000 is presented, but in the opinion of Major Bixby, concurred in by the division engineer and by me, the locality is not at the present time worthy of improvement by the General Government. The reports were transmitted to Congress and printed in House Docs. Nos. 141 and 650, respectively, Fifty-sixth Congress, first session. (See also Appendix G G 7.)

3. *Survey of Ohio River from Marietta, Ohio, to the mouth of Big Miami River.*—Major Bixby submitted preliminary report April 17, 1900. A plan for improvement by construction of 21 dams with locks at an estimated cost of $19,950,000 is presented; also an estimate of $45,000 for completing the survey. The report was transmitted to Congress and printed in House Doc. No. 648, Fifty-sixth Congress, first session. (See also Appendix G G 8.)

4. *Survey of Ohio River at Madison, Ind.*—Major Bixby submitted report April 13, 1900, with plan for improvement at an estimated cost of $50,000, and stated that should provision be made for this work it

should be by specific appropriation and not by allotment of funds from the appropriation for general improvement of Ohio River. The report was transmitted to Congress and printed in House Doc. No. 649, Fifty-sixth Congress, first session. (See also Appendix G G 9.)

5. *Survey of the river bank at Paducah, Ky. (Tennessee River), with a view to protecting the city front.*—Major Bixby submitted report April 13, 1900, with plan for improvement at an estimated cost of $166,000. He states that as the work is purely of a local nature for the protection of private property along the harbor front, and does not concern navigation in general, such work, if done at all by the General Government, should be provided for under specific appropriation. The report was transmitted to Congress and printed in House Doc. No. 644, Fifty-sixth Congress, first session. (See also Appendix G G 10.)

EXAMINATION OF OHIO RIVER (IN KENTUCKY) REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Ohio River (in Kentucky) with a view to the construction of a pier for a harbor of refuge on the south shore at or near the city of Maysville, Ky.*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF HARBOR AT PITTSBURG, PA., OF ALLEGHENY RIVER, PENNSYLVANIA, AND OF MONONGAHELA RIVER, WEST VIRGINIA AND PENNSYLVANIA.

This district was in the charge of Maj. Chas. F. Powell, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Monongahela River, West Virginia.*—Several years ago the United States built Locks and Dams Nos. 8 and 9 on the Upper Monongahela River, which extended an existing slack water upstream to beyond Morgantown, W. Va., and made that place the head of packet navigation. Previously a downstream navigation of flats and small rafts at favorable river stages only was conducted. An inconsiderable amount of rafting continues above Morgantown. Before the improvement, and as now on the unimproved part, the river on low stages was easily forded at numerous shoals and rapids. Locks Nos. 8 and 9 are of sufficient capacity for the largest packets running on the river and afford minimum sill depths at pool levels of nearly 5½ feet.

The river and harbor act of 1896 provided for the extension of slack water by the construction of six locks and dams between Morgantown and Fairmont, W. Va., 25 miles upstream, the principal object being to afford water transportation for coal from river mines near Fairmont.

The locks and dams are to be built of concrete. The total lift, 64 feet, will back the water into the mouths of the forks of the river a few miles above Fairmont. The controlling depth on the lock sills is to be 7 feet, and the chambers are to be made large enough to take in two coal boats abreast, or of the same width, 56 feet, as the large locks at the lower dams.

The locks and dams were under construction by the continuing-contract system. The contractor had commenced work in 1898 at Lock

No. 10, near Morgantown, continued there in 1899, and also made a start at site of Lock No. 11. During the past year the concrete work of Lock No. 10 was completed; 310 feet of the dam was built in two parts, leaving a gap near its middle, 133.5 feet long; a timber apron crib, 131 feet long, was built below the dam at one end, and unfinished work at the lock cribs and in bank grading was done. The contractor stopped operations last fall, leaving the bank and the lock and dam in bad shape for winter and for freshets; some damage was done to the banks, but an absence of ordinarily high freshets to the present time has probably prevented extensive and serious damage. The contract was annulled May 31, for failure to prosecute it faithfully and diligently.

Besides contract work named above, irons for Locks Nos. 11 and 12 were manufactured on awards made under competition; cross-sections were taken at sites of Locks 12–15, to cover any disturbance of the surface, and positions for the walls marked on the ground. A topographical survey was made and mapped of the upper 6 miles of the intended slack-water river and plans and specifications drawn for lock dwellings.

Upon annulment of contract, pending the making of new contracts, operations by hired labor and job work were had in protecting the unfinished structures at No. 10 from further damage by floods and for putting the works in proper shape for transfer to a new contractor.

The amount expended upon the completed project and for surveys, examinations, lands, and construction for extension of the project to June 30, 1899, was $516,694.21.

Two lines of daily packets run from Pittsburg to Morgantown and two towboats do jobbing in pools 8 and 9; such boats would probably run in the new pools, besides those which may be engaged in the expected coal traffic. The commerce accommodated at Lock No. 9 was:

Commercial statistics.

Fiscal year.	Passengers.	Freight.
	Number.	*Tons.*
1898	26,428	33,543
1899	25,310	41,503
1900	21,609	57,211

July 1, 1899, balance unexpended	$745,205.79
June 30, 1900, amount expended during fiscal year	57,121.52
July 1, 1900, balance unexpended	688,084.27
July 1, 1900, outstanding liabilities	8,931.89
July 1, 1900, balance available	679,152.38
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	350,000.00

(See Appendix H H 1.)

2. *Monongahela River, Pennsylvania.*—The act of March 3, 1899, provided for enlargement and improvement of Lock No. 6, for certain accessory structures at Lock No. 3, and for floating plant.

The amount expended on this work to June 30, 1899, was $3,768,873.68, which includes the cost of the slack-water system acquired from the Monongahela Navigation Company ($3,761,615.46).

The project adopted in 1899 provides, at Lock 6, for moving the lower gates back 6 feet, lowering the sill 12 inches, or as much thereof as practicable, and lengthening the gate walls 8 feet by concrete construction; to build a short concrete guide wall below the lock in prolongation of land chamber face; to rebuild upper miter sill, floor in head bay, and place new filling valves and lower the upper sills 1.6 feet; to lengthen the dam 7 feet; to build a 2½-foot-high movable dam on fixed dam, and make other but smaller improvements at the lock and dam. At Lock 3, to extend upper guide and mooring crib 300 feet by a concrete wall on timber-floored piling and to build a timber-crib deflecting dike about 133 feet long above lock. To build a repair steamer with snagging appliances and dipper dredge and 2 dump scows—all at a cost of $185,556.

During the year the weak timber lift wall at Lock 6 was rebuilt in substantial manner, and in plan to provide 6 feet additional length of chamber measured on axis of lock, the miter sill and also the guard sill being lowered 19 inches to give the needed and same pool draft over them as at the lower sill of the lock next upstream; the floor at head bay was rebuilt and six new steel filling valves set; the upper gate recess walls were cut back about 6 inches to give room for new gates of heavier pattern which were then erected; the upper hollow quoins of masonry were also cut out and oak quoins inserted for better distributing gate thrusts against the old and poor masonry. The work required a cofferdam, and upon trying to pump it out very extensive leaks were found under the old head floor and through the upper part of chamber river wall; the leaks were properly stopped; current caused by them had made operation of the lock difficult. While the lock was closed for the repairs, forty days, an incline transfer for steamer freight and passengers over the dam was provided. The improvement work was hampered by a freshet and an urgency to finish during severe weather for a hurried transfer of the repair boats and crews to Lock 2, where a serious accident had occurred to a wall of the large lock on the first day of an upper Ohio River coal-boat rise. Negotiations were had and are pending for river frontage, the purchase of which is necessary before building the guide wall and extension of No. 6 lock walls. At Lock 3, work on foundation for the guide-wall extension and in building the crib deflecting dike was done. Plans and specifications for a dredge boat were drawn after unsuccessful search for a suitable dredge in reach by river and which could be purchased.

The structures named in the appropriation act are part of the extensive slack-water system acquired from the Monongahela Navigation Company in 1897. A history of the system and an estimate of cost of its enlargement and improvement for affording adequate accommodation to a large and growing traffic are given in the Annual Report of the Chief of Engineers for 1897, pages 2412–2424. The traffic of the river is hampered and restricted by insufficient capacity and conveniences at the locks and in the pool channels. The tonnage of the river last year was 6,000,000.

The owner of a shallow river lot occupies the shore guide and fender crib below Lock No. 1 for about 75 feet length, with posts supporting his building. The crib was built several years ago by the Monongahela Navigation Company near the foot of a filled bank, under articles of agreement with owners of the abutting property, whose limit on the river side has been claimed as the low-water line, established about 1858 by the State of Pennsylvania. The articles of agreement stipulate in substance that when the navigation company ceased to own or operate the lock, as it has now ceased, the said owners should control the crib, which at its present location is an impediment to the service of the lock; it is old and in bad condition and should be removed and a new guide crib or wall built at and preferably behind the United States harbor line. The purchase of this lot by the United States is desirable, its cost being estimated at $12,500. At several of the locks the United States land does not extend along the shore beyond the lock wall, and at two of the locks end sections of the masonry abut on private property. Vessels owners complain of the tolls and inconveniences they are subjected to by owners of lands next to a lock when it is necessary to use the shore for changing tows or tying vessels upon entering and leaving a lock. In such cases it is thought that the riparian rights should be relinquished, or preferably, that the shore strips should be purchased by the Government. The engineer officer in charge is of the opinion that at least about $30,000 in addition to the $12,500 above mentioned could be advantageously applied for the purposes indicated.

July 1, 1899, balance unexpended	$53,043.14
Amount appropriated by sundry civil act approved June 6, 1900	135,556.00
	188,599.14
June 30, 1900, amount expended during fiscal year	12,771.27
July 1, 1900, balance unexpended	175,827.87
July 1, 1900, outstanding liabilities	6,018.03
July 1, 1900, balance available	169,809.84

(See Appendix H H 2.)

3. *Operating and care of locks and dams, Monongahela River.*—The slack-water system of the Monongahela River comprises 9 dams and sets of locks. Locks 1 to 4 are double locks; 5 to 9 are single locks. Controlling depths on sills at the different locks at pool surface vary from 4 to 6.7 feet. Effort is made to provide necessary depths during low stages for 8-foot-draft boats running below Dam 6 by putting flashboards on the dams, but this is an uncertain and otherwise unsatisfactory expedient. The locks were operated throughout the year, except that large Lock No. 2 was closed fifty-eight days for repairs due to collapse of the land wall; Lock No. 5 for thirteen days for repairs on account of scour underneath the chamber floor and lower sill; Lock No. 6 for forty days for enlargement and improvement as described in report on Monongahela River, Pennsylvania, and Lock No. 9 for fifteen days for repairs to its emptying valve. During the repairs at Lock 2 all the traffic was passed through the small lock, but with much delay, difficulty, and risk. While work was in progress at Locks 5 and 6 steamer freight and passengers were accommodated by means of inclined transfers on the dams. The walls at Locks 7 and 9 were flooded a few days, and all the locks, excepting those at Dam No. 2, were closed for several days by ice. Minor works of repair or renewal at about all the

locks and dams were done. Eight new lock gates were constructed, and a large timber shed erected at the repair yard near Lock No. 4, and a warehouse built at Lock No. 2. During the year 45,510 cubic yards of material were dredged at lock entrances or from pool channels. Nine wrecks or parts of wrecks, 169 snags, and a number of large rocks were removed from the channel.

The cost of operating the locks and dams during the fiscal year was $165,871.

Commercial statistics.

Fiscal year.	Aggregate number of lockages.	Maximum at any dam.	
		Products.	Passengers.
		Tons.	*Number.*
1898	80,885	6,117,978	157,098
1899	84,230	6,954,955	163,245
1900	75,834	5,994,975	192,652

(See Appendix H H 3.)

4. Harbor at Pittsburg, Pa.—This harbor as defined by harbor lines, established or authorized, extends from the Davis Island Dam in the Ohio River to the site of Allegheny River Dam No. 2, and on the Monongahela River to McKeesport, at the mouth of the Youghiogheny River, being an aggregate length of river of 27.5 miles. The part of the harbor most used by waiting coal fleets, and called the lower harbor, lies below Dams Nos. 1 on the Monongahela and Allegheny, and measures 8 miles of river. The general widths in the whole harbor at pool surfaces are—on the Ohio about 1,100 feet, on the Allegheny about 930 feet, and at different parts of the Monongahela from about 750 to 950 feet. The maximum draft which could be carried over the shoalest place in the coal-boat channel before improvement last year was scant 8 feet at pool stage, and that for a narrow width. The harbor was and is still partly obstructed by fillings and old structures, some submerged, projecting beyond the harbor line. Other parts of the channel are from 10 and 12 to 16 feet and even, in spots, 20 feet in depth. When the movable dam at Davis Island is down, as it unavoidably is sometimes at low stages of river, lower-harbor depths become reduced 3 and 4 feet on natural mean low river, to the serious inconvenience of coal-boat traffic, and at still lower stages cause suspension of its movement. Besides harboring coal fleets waiting to descend the Ohio River, a large local commerce is accommodated, and at times with inconvenience. The Monongahela River part serves as a refuge from Allegheny River ice. During seasons of prolonged low stage in the Ohio waiting coal fleets almost block the harbor. Thus, in 1893, according to reliable records, the fleet in the harbor at one time numbered about 50 towboats and some 1,800 craft, carrying more than 1,000,000 tons. In 1895 the fleet contained about 2,000 pieces, having cargoes of 1,250,000 tons. On June 30, 1900, about 520,000 tons of coal was afloat, besides that intended for local consumption. The ordinary maximum draft of loaded boats plying or moored in the harbor is 8 feet. The tendency is to increase the draft. Coal boats have occasionally come into the harbor from the Monongahela River drawing from 8 feet to 8 feet and 3 or 4 inches, and sometimes even as much as 8 feet 9 inches.

The act of March 3, 1899, provided for completion of improvement of this harbor upon a certain estimate of cost. The estimate proposed annual maintenance at an expense of $10,000, which item has since been incorporated in the adopted project for the improvement. This project consists, first, in dredging a channel throughout the lower harbor, where needed, 10 feet deep at pool level and 500 feet wide below Smithfield Street Bridge, Monongahela River, and above this bridge and in the Allegheny River of a less width and one limited by lines from ends of channel spans of adjoining bridges; second, raising the old riprap stone dam across Brunot Island Channel, Ohio River, and protecting its surface by large and flat pieces of stone, but leaving a channelway of 5 feet depth at pool surface; third, removal of abandoned structures and unauthorized and obstructive fillings projecting from the bank beyond the harbor line, in cases where it is impossible to secure removal except at expense of the United States; fourth, systematic and extensive marking of harbor lines and conducting inspection and patrol for execution of law for protection and preservation of harbors, and fifth, annual maintenance of the works, making local surveys and measurements, and preparation of harbor-line plats.

During the year dredging was done in the channelway to depth of 10 feet at pool stage and for bottom width of 100 feet at shoals in the Monongahela River from the Tenth Street Bridge to Wood street, Pittsburg, and for some widening of the channel at mouth of the Allegheny River; 30,565 cubic yards of material was removed, and forty-seven and three-fourths hours occupied by a dredge boat in clearing out large stones and sunken logs. Afterwards when loaded coal craft commenced to touch obstructions on the bottom at an unusually low stage of natural river, and when the clearness of the water gave good opportunity for work, 27 large stones and piece of abandoned gas main were removed. Examinations were made to determine locations and limits of further dredging most needed and of places for disposal of dredged material; also a survey to determine the low-water slope and give careful soundings of Glasshouse Bar at head of Brunot Island, Ohio River, for arranging for improvement of its channel without materially altering the low-water surface in the harbor above. Efforts were made to have the channel deepened or widened at various places by the sand and gravel dredges operated by private companies under permits, but little was accomplished in that direction except at Garrison Bar in the Allegheny River. A cut across this bar, 300 feet wide, was defined by range marks and the work of such dredges there kept within the cut, which was thereby about one-half completed, or for about 800 feet in length. Work of raising Brunot Island riprap dam to give a uniform depth over it of 5 feet at pool stage was completed; 2,237.5 cubic yards of stone was used. Operations were conducted to secure removal of abandoned river structures. Systematic location and prominent marking of established harbor lines progressed, but was interrupted and delayed by urgent need of numerous local harbor-line locations, requiring detached surveys, which were made, however, with a view of connection into one system. Thorough patrol and inspection of the harbor and banks were exercised, and the prevention or stoppage of deposits over the banks, improper dumping in the rivers, and encroachments of unauthorized structures beyond harbor lines was accomplished in a large number of cases. For extension of the Monongahela River harbor lines from Homestead to McKeesport at the mouth of the Youghiogheny River a set of maps in seven sheets was prepared from a detailed survey, based on a triangulation; and a harbor line, as selected after public hearings and much study were had for recommendation for establishment, was drawn on the map and partly marked on the ground.

The routes of six Ohio River and three Monongahela River packet lines, using 19 steamers for passengers and freight, terminate at Pittsburg. The total water-borne tonnage of the harbor and number of passengers carried for 1899 are found after careful compilation to be 8,813,166 and 1,318,323, respectively. The principal item of the tonnage is coal, both for local consumption and for shipment down the Ohio River. The passenger item is made up principally from local excursions.

July 1, 1899, balance unexpended	$110,662.90
June 30, 1900, amount expended during fiscal year	22,488.38
July 1, 1900, balance unexpended	88,174.52
July 1, 1900, outstanding liabilities	1,143.19
July 1, 1900, balance available	87,031.33
Amount (estimated) required annually for completion of existing project.	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix H H 4.)

5. *Locks and dams at Herr Island, head of Six-mile Island, and at Springdale, Allegheny River.*—The originally adopted project providing for the Herr Island Lock and Dam contemplated that the dam should be a fixed one; but in compliance with a request of municipal authorities the plan was changed to a movable dam, and to satisfy local riparian owners the position of the lock was changed so that a slip or basin, 55 feet wide and open at its lower end, is left between the lock and the river bank. The site of the Herr Island works is in the pool of the Davis Island Dam of the Ohio River, 6.3 miles below, which gives a pool depth in the Allegheny River channel of 8 to 9 feet as far as Garrison ripple, above Herr Island Dam and about 2 miles above the mouth of the river. The completion of the project will extend the useful part of Pittsburg Harbor 4.5 miles upstream. The lower sill of the lock has a pool depth of 8 feet; the upper sills and the sill of the navigable pass of the dam have 6 feet pool depths. The lowering of the upper sills 2 feet has been authorized, for giving better accommodation to navigation when the Davis Island and Herr Island dams are down and the river is low, a condition which will obtain more or less each year.

The river and harbor act of 1896 provided for the construction of two additional locks and dams which will extend slack water, having 7 feet minimum pool depth on lock sills, from Herr Island 17 miles, or to Natrona.

The locks are of concrete construction. Dams Nos. 2 and 3 are to be fixed timber dams.

The lock at Herr Island and some accessories had been completed, the Chanoine wickets and irons for the navigable pass obtained, and the building of the foundation of the pass commenced. During the year 250.2 feet of the pass were completed, the wickets erected, and temporary works and débris removed after much difficulty, interruption, and delay in the contract work. Part of coffer to be retained was prepared for the purpose and protecting piles driven. Entrances to the lock were cleared by hired dredging of old anchor cribs, pieces of cofferdam, and other obstructions. Contracts were made for completion of the movable dam and for building the lock gates and guide cribs. A good start has been made on these works, and the present season, if favorable, should see them completed, and the Herr Island Lock and Dam about ready for operation.

The contractor at Six-mile Island and Springdale had commenced on the lock opposite the latter-named place; during the year he completed it and partly built guard and apron cribs and guide walls, and is now at work upon their completion and in dredging at site of dam and abutment.

The location for the lock at Six-mile Island is at a rapid, and its cofferdam would occupy nearly all of the present available channel. The contractor had chosen to work at Springdale and not commence at Six-mile Island until he would have the considerable benefit of slack water from Herr Island Dam, as expected when the contract was entered into for the Six-mile and Springdale structures. The order in building these works is not material. Moreover, while the Six-mile Island Lock will be built outside of low-water line, or in the river, the title to the adjacent lock ground needed for working room has not yet been obtained. This is a narrow, unoccupied strip along the water edge at the foot of a steep railroad embankment, belonging to the city of Pittsburg, whose officials at the beginning expressed a willingness to have the city deed the same to the United States for $1. On the strength of this offer in writing the contract for the lock and dam was made and the land at the abutment end of the dam purchased. Afterwards the city's representative declined to transfer title to the lock ground, but demanded that the United States should first extend an existing large storm-water sewer now emptying into the river above the dam to some point below. Such extension of the city sewer would cost $40,000 or more. Subsequently the city was offered $1,400 for the desired lock land or twice the amount paid for the larger piece of ground at the Springdale lock. No satisfactory answer has been received. It is reported that late advices are that the matter will be further considered and answer duly made. In the meantime examinations as to foundation for structures at and cost of another site heretofore considered unavailable for the lock and dam are being made; this alternative site appears promising in both respects named and preferable for other good reason.

The amount expended upon the whole project to the close of the year ending June 30, 1899, was $358,437.37.

Herr Island Dam is in Pittsburg Harbor, the Allegheny River part of which had a tonnage last year of about 2,571,000; the upper river traffic passing Springdale and Six-mile Island was about 364,000 tons. Increases of each upon completion of the slack-water improvement are expected.

July 1, 1899, balance unexpended		$529,062.63
June 30, 1900, amount expended during fiscal year		130,516.44
July 1, 1900, balance unexpended		398,546.19
July 1, 1900, outstanding liabilities	$28,364.65	
July 1, 1900, amount covered by uncompleted continuing contracts	[1]436,836.65	
		465,201.30

Amount (estimated) required for completion of existing project	244,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	244,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 5.)

6. *Allegheny River, Pennsylvania.*—In its original condition the Allegheny River, having a hard gravel and sand bottom, with an average slope of 2.06 feet per mile for a distance of 126.5 miles between its mouth and French Creek, at Franklin, Pa., and an average slope of 3.4 feet per mile over 132 miles between Franklin and Olean, N. Y., was obstructed by numerous large bowlders, which reduced the low-water navigable depth as much as 2 feet on various ripples, and made navigation over them extremely hazardous at ordinary stages. The river also embraced several wide-spreading shoals, giving an available navigable depth at low water of less than 6 inches. The originally adopted plan of improvement of the river, which has not been materially changed, contemplates the removal of bowlders, snags, and other obstructions from the channel and the construction of low dams to close duplicate channels and of dikes to confine the waterway on extensive shoals. There had been expended under this project, from the date of the first appropriation in 1879, to the close of the fiscal year ending June 30, 1899, the sum of $229,971.22, about two-thirds of which had been devoted to the removal of new rock obstruction washed out from the banks and those brought down by the rapid tributaries or moved along the river bed by the action of freshets and ice. The latter is a powerful agent in modifying the river bed. The result had been a marked improvement, furnishing a least depth of 1.4 feet over the shallowest bars at low water, with ample width of channel and a consequent lengthening of the period of practicable navigation, and permitting rafting and floating downstream of coal-boat bottoms to be done on stages a foot lower than formerly. The low stages are valuable for steamboating, as numerous low bridges block such navigation at even mean stage of river. The improvement previously secured was partly lost in 1899 on account of the absence of any work of channel maintenance, which was prevented by the depleted condition of the appropriation.

During the year ending June 30, 1900, Red Bank Dike was materially repaired and paving laid on an extension for which there were not sufficient funds when it was made. Nicholson Dam was also extensively repaired. Smaller repairs were made to the log chute in Corydon Dam, the dam at Hickory and Cowanshannock Dike No. 1. The dams at Cornplanter, Tionesta, and Pithole and Cowanshannock Dike No. 2 were in good condition. Three parties having teams, implements, and explosives removed rock and other obstructions from the channel between Hickory and Pittsburg Harbor, a distance of 153 miles, burning or depositing them against dams, caving banks, or in unused or abandoned chutes; 41 snags, 4,419 cubic yards of rock and 550 of heavy gravel were so handled, leaving the channel thereby fairly free from such obstructions. An allotment of $5,000 for snagging work was made August 17, 1900, from the appropriation made available by the emergency river and harbor act approved June 6, 1900.

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[1] Amount includes contract approved July 11, 1900, with Thomas Marshall for bear-trap gates.

The principal river traffic consists of rafting, running downstream coal-boat bottoms and new barges, generally loaded with lumber, hay, or tan bark, and towage of flats of sand, gravel, and stone. A small packet business was conducted between Pittsburg and Kittanning during the fall and spring months. The tonnage on the part of the river above slack-water improvement in progress was, in round numbers, for calendar years:

1897	$437,000
1898	294,000
1899	364,000

July 1, 1899, balance unexpended	$15,028.78
June 30, 1900, amount expended during fiscal year	12,446.07
July 1, 1900, balance unexpended	2,582.71
July 1, 1900, outstanding liabilities	321.48
July 1, 1900, balance available	2,261.23
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	18,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix H H 6.)

SURVEY OF WEST FORK RIVER, WEST VIRGINIA, MADE IN COMPLIANCE WITH JOINT RESOLUTION OF CONGRESS APPROVED APRIL 29, 1898.

The survey of *West Fork River, West Virginia, from its mouth to the city of Clarksburg*, with a view to its improvement by locks and dams, was made by Maj. Chas. F. Powell, Corps of Engineers, and report thereon submitted October 31, 1899, through the Division Engineer, Col. Henry M. Robert, Corps of Engineers. He presents a plan for improvement by construction of six locks and dams at an estimated cost of $996,000, but states that the locality is not worthy of slack-water improvement by the General Government, and his views are concurred in by the division engineer. The report was transmitted to Congress and printed in House Doc. No. 88, Fifty-sixth Congress, first session. (See also Appendix H H 7.)

EXAMINATION OF YOUGHIOGHENY RIVER, PENNSYLVANIA, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination of the *Youghiogheny River, from West Newton to the mouth at McKeesport, Pa.*, was made by the local engineer, Maj. Chas. F. Powell, Corps of Engineers, and report thereon, dated September 27, 1899, submitted through the Division

Engineer, Col. Henry M. Robert, Corps of Engineers. A plan for improvement by construction of three locks and dams, at an estimated cost of $599,106, is presented, and Major Powell states that in his opinion this section of the river is worthy of slack-water improvement by the General Government.

In forwarding the report to this office the division engineer expressed the opinion, for reasons stated, that the locality was not worthy of improvement as proposed; but in a subsequent letter of July 24, 1900, a copy of which has been attached to the report, he stated that for reasons set forth therein, he has changed his opinion as to the worthiness of the improvement of this stream by the General Government.

The report was transmitted to Congress and printed in House Doc. No. 82, Fifty-sixth Congress, first session. (See also Appendix H H 8.)

IMPROVEMENT OF MUSKINGUM RIVER, OHIO, AND OF CERTAIN RIVERS IN VIRGINIA, WEST VIRGINIA, AND KENTUCKY, TRIBUTARY TO OHIO RIVER.

This district was in the charge of Capt. Harry F. Hodges, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Muskingum River, Ohio.*—Many repairs and some reconstruction work were necessary when the United States assumed charge of the slack-water navigation on the Muskingum River, in 1887. This report is limited to work carried on under an appropriation of $102,000 by act of August 11, 1888, for the construction of a lock at Taylorsville and the reconstruction of the lock at Zanesville, Ohio; and to work carried on under an allotment of $6,000 from the appropriation of $300,000 by act of July 1, 1898, for improving harbor at Cleveland, Ohio, set apart for repair and extension of the levee of the Muskingum River at Zanesville, Ohio.

The original condition of the waterway was as described in the report for operating and care of locks and dams on Muskingum River.

The original project contemplated the construction of a lock at Taylorsville and the reconstruction of a lock at Zanesville.

The repair and extension of the levee at Zanesville was added by the act of July 1, 1898.

Up to the close of the fiscal year ending June 30, 1899, there had been expended on this project the sum of $97,329.93. At that date the lock at Taylorsville had been completed and opened to navigation. The reconstruction of the Zanesville Lock had been indefinitely postponed, and the money available for it had been diverted by Congress to other uses.

Land for a lock house at Marietta had been purchased and a contract for the construction had been awarded. Work on the repair and extension of the Zanesville levee was suspended pending the acquisition of certain necessary easements from the owners of the land to be occupied.

During the fiscal year ending June 30, 1900, the lock house at Marietta has been finished and the grounds cleared, the easements needed for the repair and extension of the Zanesville levee have been obtained and the work finished.

For the reasons stated in the last annual report the recommendation is renewed that an additional appropriation of $14,000 be made for building five dwellings for lock tenders and for raising the crests of Dams 3 and 9.

A draft of 6 feet can be carried through the Taylorsville lock at mean low water. The minimum mean low-water depth on the entire Muskingum River system is 3 feet, at Lock No. 1.

The commercial statistics for this work can not be separated from the general commerce of the Muskingum River, and are reported under the head of operating and care of locks and dams on the Muskingum River.

July 1, 1899, balance unexpended	$10,670.07
June 30, 1900, amount expended during fiscal year	9,485.88
July 1, 1900, balance unexpended	1,184.19
July 1, 1900, outstanding liabilities	3.18
July 1, 1900, balance available	1,181.01
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	10,300.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I I 1.)

2. *Operating and care of locks and dams on Muskingum River, Ohio.*—As originally improved by the State of Ohio, 11 dams and 12 locks were built on the 91 miles of river from its mouth in the Ohio at Marietta to Dresden, where connection was made with the Ohio Canal, which carried the slack-water navigation to Lake Erie at Cleveland. The lock and dam above Zanesville are now in a state of ruin, but the 75 miles of slack water between Zanesville and the Ohio River has been maintained. The locks and dams on this part of the river passed into the hands of the United States in 1887. All the works were in bad repair and much reconstruction was unavoidable.

Up to June 30, 1899, a total sum of $1,270,498.25 had been expended in general repairs and in operating and caring for the locks and dams, and an additional sum of $17,190.44 in building a protection wall at Zanesville and altering the bridges at Taylorsville and Marietta.

At that date the works had been placed generally in good condition. The system was available for boats small enough to pass the locks, which have a length of 180 feet between hollow quoins, with a width of 36 feet, and a depth over the sills at mean low water of 6 feet at 9 of the 11 locks, 3 feet at one, and 5 feet at the other.

The work during the past fiscal year has been confined to operating and caring for the system, which has been maintained in good condition. The river was closed by ice for four days in December, 1899; nineteen days in January, fifteen days in February, and five days in March, 1900.

The United States dredge and a towboat were usefully employed during the year in making and maintaining good navigable depth and width in the channels.

In general, the system is in good condition at the close of the fiscal year. Dams Nos. 3 and 6 should be raised in order to afford full depth at the heads of the pools above; and Lock No. 1, at Marietta, which was badly damaged by an accident in 1896, still leaks through the floor at intervals. Extensive repairs, which alone can make this lock entirely secure, are not recommended for the present, since the proposed construction of a dam in the Ohio below Marietta may so reduce the pressure on the Muskingum River lock as to obviate the necessity of reconstruction. For the present, temporary repairs from time to time are considered sufficient. With the exceptions named, the repairs needed are of a minor nature.

The total commerce for the calendar year 1899 was 70,206 tons of freight, valued, approximately, at $4,000,000, and 100,756 passengers.

The expenditures during the fiscal year ending June 30, 1900, amounted to $39,537.55.

(See Appendix I I 2.)

3. *Little Kanawha River, West Virginia.*—At the time of the adoption of the original project for improvement there were four locks and dams in the stream, owned and controlled by the Little Kanawha Navigation Company, which afforded slack-water navigation from Parkersburg up to a point 2 miles above Burning Springs, W. Va., or a total distance upstream from Parkersburg of 41 miles. Above Burning Springs the river was much obstructed by logs, snags, bowlders, leaning trees, etc., rendering the floating of timber, the principal commodity, very hazardous.

The original project, adopted in 1877, provided for the removal of Beaver and Nailor Bend rocks, 53 and 54 miles, respectively, above Parkersburg, and for clearing the stream above Burning Springs of snags and overhanging and fallen trees.

There was added to the original project, by the act of Congress of June 14, 1880, provision for the construction of a lock and dam 2 miles above Burning Springs.

The amount expended up to June 30, 1899, was $212,426.63. At that date the upper part of the stream had been placed in a fair condition for timber-floating purposes, so that, on moderate rises, light-draft steamboats could run as far as Grantsville, 77 miles above Parkersburg. The lock and dam, known as No. 5 of the system, and their appurtenances, 2 miles above Burning Springs, were completed and opened to navigation on December 2, 1891. This lock and dam and the four locks and dams owned by the navigation company afford 4 feet of slack-water navigation up to Creston, 48 miles above Parkersburg, when the supply of water in the stream is greater than the leakage through the dams of the navigation company, the condition of which is fully described in the Annual Report of the Chief of Engineers for 1895, pages 2520–2525.

During the fiscal year ending June 30, 1900, obstructions were removed from the channel between Glennville, 102½ miles above Parkersburg, to Dam No. 5, 40¾ miles above Parkersburg. Work was suspended on October 10, 1899.

While the work did not result in any increased depth of navigable channel it facilitated the operation of light-draft craft.

The maximum draft which can be carried at mean low water over the shoalest place in the part of the river under improvement is 6 inches.

A statement of commerce on this river is given under the report for operating and care of lock and dam on Little Kanawha River, West Virginia.

July 1, 1899, balance unexpended	$991.37
June 30, 1900, amount expended during fiscal year	819.63
July 1, 1900, balance unexpended	171.74

(See Appendix I I 3.)

4. *Operating and care of lock and dam on Little Kanawha River, West Virginia.*—The lock and dam, known as No. 5 of the system, and located about 2 miles above Burning Springs, W. Va., or about 41 miles above Parkersburg, W. Va., were constructed under the additional project for improving Little Kanawha River, West Virginia, adopted in 1880. Lock No. 5 was opened to navigation on December 2, 1891, and has been in condition to be operated ever since that date, with the exception of a few days when it was closed for minor repairs. When the supply of water in the stream is more than the leakage through the four dams owned and operated by the Little Kanawha Navigation Company below No. 5, 4 feet of slack-water navigation is afforded in this stream from its mouth at Parkersburg, W. Va., up to Creston, W. Va., about 50 miles above Parkersburg.

The character of the four locks and dams controlled by the navigation company below No. 5 and their condition are described in the Annual Report of the Chief of Engineers for 1895, pages 2520–2525.

The amount expended up to June 30, 1899, was $21,518.68 in operating the lock and making minor repairs to the lock, dam, and appurtenances.

On June 30, 1899, the work was in good condition.

The amount expended during the fiscal year ending June 30, 1900, was $2,421.61. With this sum the lock, dam, and appurtenances have been operated and cared for, necessary repairs have been made, and about 1,750 square feet of the terreplein have been paved.

At the close of the year the lock was in good working order.

The depth at pool level over the lower sill, which is the shoalest part of the lock, is 4 feet. When the pool below is drained down by reason of leaks in the dam below the depth is less.

During the year navigation was suspended for one hundred and twenty days due to low water in the pool below, and for twenty days due to ice.

The commerce that has passed Lock No. 5 since it was opened to navigation, and which has consisted almost wholly of timber, is as follows:

Fiscal year—	Tons.	Fiscal year—	Tons.
1890	140,115	1896	105,212
1891	190,688	1897	176,169
1892	244,254	Calendar year—	
1893	137,072	1897	127,943
1894	106,412	1898	122,405
1895	179,240	1899	138,664

(See Appendix I I 4.)

5. *Kanawha River, West Virginia.*—This river flows through a region rich in mineral wealth, especially coal and salt. It was originally divided into a number of pools separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation during the low-water period of each year, there being but a few inches of water on the shoal places at such times. Navigation was practically suspended in summer.

The original project, adopted in 1873, provided for removing large bowlders from the channel, excavating channels through the shoals, and constructing riprap dams and dikes, the object being to increase the depth of water on the shoal places so as to enable towboats to use the stream for a longer period each year than its natural condition permitted.

The modified project, adopted in 1875, provided for obtaining the depth of 6 feet of water all the year round throughout the whole river, 96 miles, by the construction of locks with movable dams from the mouth in the Ohio, at Point Pleasant, W. Va., up to Paint Creek, about 79 miles above Point Pleasant, and locks with fixed dams above Paint Creek, the declivity of the river above Paint Creek being too great to permit of the advantageous use of movable dams. The original estimated cost of this improvement was placed at $4,153,000. This sum was somewhat lessened by reducing the total number of locks and dams from 12 to 11, one of the locks and dams originally estimated for in the lower portion of the river having been found, after more detailed examination, to be unnecessary. The original project also provided for three locks with fixed dams in the upper part of the river; only two of these have been constructed, Nos. 2 and 3, the construction of No. 1 having been dispensed with until its necessity shall become more apparent. By dropping these two locks and dams from the original project the original estimate was reduced by about $600,000. However, the revised estimate of 1892 (Annual Report of the Chief of Engineers for 1892, pp. 2042–2044) showed that $1,305,700 still remained to be supplied by Congress in order to complete the project. This amount was appropriated by the acts of July 13, 1892, March 3, 1893, and March 2, 1895. The estimate of 1892 was made, however, before the exact site of Lock and Dam No. 11 had been selected, before a thorough knowledge of the amount of dredging between locks was had, and before the existence of the law limiting a day's work of a Government employee to eight hours. A revised estimate was therefore found necessary in 1896, and the amount of it, $273,000, was appropriated in the sundry civil act of June 4, 1897. It is thought the project may be completed without further appropriations.

Up to June 30, 1899, there was expended under the original project of 1873 $50,000, and under the modified project of 1875 a total of $3,944,029.67.

Locks and Dams Nos. 2 to 11, inclusive, had been finished and opened. A large amount of dredging and channel work had been accomplished and the necessary plant procured and operated. To complete the project from pool No. 2 to the mouth of the river required only the construction of some of the lock houses, the continuance and completion of the dredging and channel work, and the renewal of some of the plant for this purpose.

The expenditures during the fiscal year ending June 30, 1900, have resulted in finishing four lock houses and partially finishing four more; in the purchase of a new crane boat; in clearing certain channels and the approaches to locks of obstructions, and in the preparation of plans and specifications for a new towboat.

The sum of $2,214 was awarded in the United States Court of Claims to M. Alfred Pasqueau, for the use of his patented heurter in certain of the dams.

Suits were filed in the United States Court of Claims by Carkin, Stickney & Cram, contractors for Lock No. 7, and by Zimmerman, Truax & Sheridan, contractors for Locks and Dams Nos. 9 and 10, claiming certain sums alleged to be due for extra work under the contracts.

The maximum draft which can be carried at the shoalest part of the slack-water system at mean low water is 6 feet.

Commercial statistics are given in the report for operating and care of locks and dams on Kanawha River.

July 1, 1899, balance unexpended		$214,170.33
June 30, 1900, amount expended during fiscal year		18,981.72
July 1, 1900, balance unexpended		195,188.61
July 1, 1900, outstanding liabilities	$44.46	
July 1, 1900, amount covered by uncompleted contracts	3,493.20	
		3,537.66
July 1, 1900, balance available		191,650.95

(See Appendix I I 5.)

6. *Operating and care of locks and dams on Kanawha River, West Virginia.*—Slack-water navigation on the Kanawha River extends from Lock No. 11, at Point Pleasant, 1¼ miles above the Ohio River, to Loup Creek Shoal, 90 miles above the Ohio River. There are 10 locks with dams, 2 of which are fixed and 8 movable, on the Chanoine system. The locations are given in the Annual Report of the Chief of Engineers for 1899, page 428. As these locks and dams have from time to time been opened to navigation, the maintenance of them has devolved upon the indefinite appropriation of July 5, 1884, for operating and care of canals and other works of navigation. Projects and estimates for this work are submitted annually. At the close of the fiscal year ending June 30, 1899, the entire system was so maintained. The total disbursements up to that date had been $342,793.86, which had been used in the current work of operating and caring for the finished locks and dams, making renewals of those parts of the works which had deteriorated from use and exposure, and in dredging deposits from the lock chambers and entrances and from the channels between the locks, which had been originally formed by dredging, under the appropriations for "Improving Great Kanawha River."

During the year ending June 30, 1900, the system has been operated and kept in repair. Navigation was interrupted for 28 days at the fixed dams by ice and by high water. At the movable dams there was no interruption to navigation, except at Nos. 4 and 5. Lock No. 4 was closed from November to May for the purpose of replacing the gates. During the greater part of this time, however, there was no interruption to navigation from that cause, since the dam was down and boats, if running, could use the navigable pass. At No. 5 an accident to the gates caused locking to be suspended for 48 hours. On the last day of the fiscal year the trestles of the weir of Dam No. 6 were seriously injured by rafts, logs, and drift carried down upon them from Elk River, 4 miles above, from which they had been floated out by a violent and sudden flood, due to a cloudburst. The wickets of the dam were uninjured, and the accident will cause practically no interruption to navigation.

Great assistance has been afforded to the coal trade during the year by the use of the water in the Kanawha River pools to augment small rises in the Ohio River, thus creating in the latter a stage of water sufficient to carry to market the boats and barges accumulated at the lower end of the Kanawha River. This operation was attempted experimentally for the first time on November 6, 1899, and has been tried twice since then with marked success.

The amount expended during the fiscal year ending June 30, 1900, was $45,215.73.

The commerce of the Kanawha River since 1889 has been as follows:

Fiscal year—	Tons.	Fiscal year—	Tons.
1890	1,127,232	1886	1,162,782
1891	1,225,355	1897	1,124,843
1892	1,360,750	Calendar year—	
1893	1,116,537	1897	832,002
1894	1,222,530	1898	1,244,334
1895	1,082,342	1899	1,124,364

The shipment, by river, of coal, which is the principal commodity, in 1875, when the improvement began, was about one-sixth of its present volume.

(See Appendix I I 6.)

7. *Elk River, West Virginia.*—This stream is one of the chief tributaries of the Kanawha River, emptying into it at Charleston, W. Va. Its course is tortuous, but the country through which it flows is rich in minerals and well fitted for agriculture and grazing. The stream was originally much obstructed by snags, rocks, overhanging trees, and was a succession of pools separated by rapids at shoals, over which latter, during dry seasons, there was but a few inches of water.

The project was adopted in 1878 (Annual Report of the Chief of Engineers for 1876, pp. 166–176), and provided for improving the stream for bateau navigation by cutting sluices through the shoals. The estimated cost of this "open" navigation was placed at $100,000.

Up to June 30,1899, $27,250.41 had been expended, which had resulted in the removal of snags, rocks, overhanging trees, the construction of cheap regulating dams to concentrate the water at some of the worst shallow places, and the making of narrow sluices through some of the rapids and shoals, so as to aid the transportation of country produce downstream in small boats and the return of the latter with merchandise, and also the floating of timber to market.

At that date the river was available for the class of traffic for which it had been improved. No work was going on, but preparations were in progress to begin at an early date, with the balance of available funds, the expenditure of which had been ordered by the river and harbor act of March 3, 1899.

On July 22, 1899, work was resumed and carried on until November 22, 1899, clearing about 113 miles of the channel.

At the close of the fiscal year the river was in better condition for navigation than it has been for some years; but no steamboats are running.

A preliminary examination of the river was made in compliance with the provisions of the river and harbor act approved March 3, 1899. Report thereon was printed in House Doc. No. 70, Fifty-sixth Congress, first session, and is also submitted herewith as Appendix I I 16.

The maximum draft which can be carried at mean low water over the shoalest part of the improved river is about 2 feet.

Commercial statistics.

Fiscal year—	Tons.	Fiscal year—	Tons.
1883	24,790	1893	125,400
1884	30,700	1894	92,630
1885	33,500	1895	112,100
1886	68,510	1896	92,000
1888	71,150	Calendar year—	
1889	70,200	1897	72,707
1890	89,880	1898	55,500
1891	103,700	1899	51,800
1892	139,800		

This commerce has consisted almost entirely of timber—logs, lumber, ties, and staves.

July 1, 1899, balance unexpended	$3,249.59
June 30, 1900, amount expended during fiscal year	2,996.46
July 1, 1900, balance unexpended	253.13
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	69,000.00

(See Appendix I I 7.)

8. *Gauley River, West Virginia.*—The country at the head waters of this stream and its tributaries is covered with forests of the finest timber. For the first 12 miles from its mouth in the Kanawha River, or junction with New River, the Gauley falls only 4 feet per mile; in the next 26 miles its fall is nearly 34 feet per mile, in a gorge, the hills on either side being several hundred feet high and almost perpendicular, and the stream full of bowlders, some very large, and so numerous as to justify the name of "Roughs of Gauley" which has been given that section.

The project was adopted in 1888 (Annual Report of the Chief of Engineers for 1888, pp. 1761–1767), and provided for 2-foot navigation for bateaux carrying 8 to 10 tons, and for rafts of logs, sawed stuff, railroad ties, etc., from the mouth of the river to the foot of the Roughs, about 12 miles, and for improving the condition of the Roughs for about 28 miles farther, by blasting down the huge bowlders which formed such formidable obstructions.

The sum of $11,359.35 was expended up to June 30, 1899, principally below the Roughs, in providing and maintaining 2-foot navigation for bateaux and for rafts, and in commencing work at the Roughs.

On August 30, 1899, work which had been suspended since the autumn of 1894 was resumed between Carnifax Ferry and Sugar Creek, a distance of 18 miles. Operations were suspended on November 14, 1899. The work was done at the head of the Roughs, above the part of the river at which the previous appropriations had been expended. The result was to enable logs to be floated over the part of the channel where the work was done at a stage lower by 5 feet than hitherto. There is no commerce on the river except timber, and the indications are that even this will practically cease so soon as the region obtains facilities for shipping lumber by rail.

The maximum draft at mean low water for the first 10 miles is about 3 feet; above that point, less than 1 foot.

July 1, 1899, balance unexpended	$3,640.65
June 30, 1900, amount expended during fiscal year	3,331.95
July 1, 1900, balance unexpended	308.70
July 1, 1900, outstanding liabilities	4.50
July 1, 1900, balance available	304.20
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	60,000.00

(See Appendix I I 8.)

9. *Guyandot River, West Virginia.*—The stream was practically closed before work was commenced. It was once improved by the State of Virginia by the construction of six timber locks and dams. These structures decayed, were abandoned, and became themselves obstructions to navigation. They were finally carried away by floods, and at the time the improvement was commenced by the United States the principal obstructions were snags, rocks, shoals, and overhanging trees.

The approved project for the improvement of this river, adopted in 1878, provides for obtaining a clear channel for a distance of 122 miles upstream from its mouth, with a width of from 30 to 50 feet, and with a least depth of 18 inches during five months of the year, the same to be obtained by the removal of obstructions, such as logs, snags, stumps, rocks, and overhanging trees, and by the construction of low stone dikes at shoals, so as to concentrate and increase the depth of water at such points.

The purpose of the improvement is to aid light-draft steamboat navigation in the lower portion of the stream and the floating of timber down to the Ohio and thence to market. The work is done by hire of labor.

Up to June 30, 1899, $21,503.69 had been expended, resulting in the partial improvement of the river for the distance of 119 miles upstream from its mouth, removing snags, logs, etc., cutting passageways through old dams, and constructing low dams of loose stones to deepen the water on shoals.

At that date the improvement was available for logs and light-draft steamers. The usefulness of the river was restricted by two dams, Peck's and Lambert's, respectively about 73 and 54 miles above the mouth.

In the river and harbor act of March 3, 1899, Congress appropriated $1,000 for maintenance of the improvement and ordered a preliminary examination of the lower 50 miles of the river.

The appropriation was expended in field work during the past year, clearing many obstructions from the lower 50 miles of the channel. The preliminary examination was made, and report thereon, dated September 13, 1899, was transmitted to Congress and printed in House Doc. No. 64, Fifty-sixth Congress, first session, and is also submitted herewith as Appendix I I 17.

On June 30, 1900, the conditions as to availability for commerce remained the same as at the close of the preceding fiscal year.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the locality under improvement, was about 20 inches.

Commercial statistics.

Fiscal year—	Tons.	Fiscal year—	Tons.
1891	61,128	1897	143,300
1892	103,800	Calendar year—	
1893	182,250	1897	190,000
1894	141,221	1898	158,000
1895	247,400	1899	110,000
1896	202,000		

The commerce consists almost entirely of timber, cross-ties, etc.

July 1, 1899, balance unexpended	$996.31
June 30, 1900, amount expended during fiscal year	996.09
July 1, 1900, balance unexpended	.22

(See Appendix I I 9.)

10. Big Sandy River, West Virginia and Kentucky.—In its original condition this river and its forks were much obstructed by rocks, bars, snags, and leaning trees. During the low-water period of each year navigation was practically suspended.

The original project, providing for the removal of rocks, snags, and overhanging trees from the main stream and the Levisa and Tug forks, which unite at the town of Louisa, Ky., to form the main stream, was for "improving Big Sandy River from Catlettsburg, Ky., to the head of navigation," and was adopted in 1878 (Annual Report of the Chief of Engineers for 1875, pp. 756–769). This improvement was for the purpose of aiding light-draft steamboat, push boat, and rafting navigation on the main river and the Tug and Levisa forks.

In 1880 the appropriations for the forks were made distinct from that for the main river, and three works resulted, which remained separate until the appropriation of March 3, 1899. At the same time the project of 1878, for the improvement of the Big Sandy proper, was so modified as to provide for the construction of a lock and fixed dam in that stream at Louisa, immediately below the junction of Levisa and Tug forks. In 1891, after the lock and a portion of the fixed dam at Louisa had been completed, the protests of those interested in the timber business against a fixed dam caused the substitution of a needle (movable) dam for the proposed fixed dam. This change of project was approved November 20, 1891.

The present project, submitted April 27, 1898, and adopted in the river and harbor act of March 3, 1899, contemplates carrying slack water from the Ohio River to Pikeville on Levisa Fork, and the mouth of Pond Creek on Tug Fork, by the construction of 21 locks and movable dams, in addition to the one already built below Louisa. The cost of these additional works is estimated at $4,725,000.

Up to June 30, 1899, the expenditures had aggregated $381,339.70, with results as follows:

Under the project for the removal of obstructions the channel had been cleared and maintained from 1878 to 1880.

Under the modified projects of 1880 and 1891, a lock and movable needle dam had been finished and opened to navigation. As this dam is the only one yet built on the river, it has little influence on the general commerce.

The survey provided for in the act of March 3, 1899, had also been begun.

During the fiscal year ending June 30, 1900, nothing was done toward removing obstructions in the main river, for lack of funds. The office building and lock grounds were improved somewhat with a small balance available for this purpose. Under the appropriation of March 3, 1899, sites for two locks and dams below Louisa were selected, and nearly all of the necessary land was purchased. Plans for Lock No. 1, at Catlettsburg, were approved, and bids for the work were invited, but no contract has yet been made, as it was not apparent from the proposals received that the two locks and dams could be completed within the limit of the authority for continuing contracts granted in the act of March 3, 1899, which limit was less by 10 per cent than the estimated cost of the work, as stated in the report upon which the legislation was based.

The field work of the survey was practically finished and the plotting begun.

The work done was necessary to prepare for the construction of the locks and dams contemplated for the future, but from its nature can not in itself give any increased facilities to commerce.

The maximum draft which can be carried at mean low water over the shoalest part of the river below Pikeville and Pond Creek is 20 inches.

Commercial statistics.

Fiscal year—	Tons.	Fiscal year—	Tons.
1890	268,582	1896	471,382
1891	277,303	1897	414,500
1892	455,926	Calendar year—	
1893	466,723	1897	406,900
1894	297,800	1898	415,400
1895	545,910	1899	328,272

The above is the commerce of the three streams—Big Sandy proper, from Louisa, Ky., to its mouth in the Ohio at Catlettsburg, Ky., a distance of 26 miles, and of Levisa and Tug forks, which unite at Louisa to form the main river. This commerce consists of timber and farm products. The amount can not well increase until slack water has been extended by additional dams above and below the single dam now in place.

The country bordering Levisa and Tug forks abounds in bituminous, cannel, and coking coal of good quality, but it remains undeveloped for lack of transportation facilities. All the appropriations made since 1880 for the main river have stipulated that the funds should be expended in constructing the lock and dam near Louisa, so that nothing has been done toward the removal of natural obstructions in the main river between the lock and Catlettsburg for about seventeen years. This portion of the river has become more or less obstructed in that time, and it is estimated that these obstructions may be cleared out at a cost of $2,000.

Of the limiting sum fixed by Congress for the two locks and dams below Louisa only $140,000 remains to be appropriated, and this amount is included in the estimates to be considered by the committees of Congress in connection with the preparation of the next sundry civil bill. Inasmuch, however, as it is now estimated that $70,000 in addition to this sum will be required to complete the works, an estimate of $70,000 has been inserted in the estimates to be considered by the committees having in charge appropriations for the improvement of rivers and harbors, the total amount (estimated) required to complete the two locks and dams being $210,000.

An allotment of $1,000 for snagging was made July 7, 1900, from the appropriation provided by the emergency river and harbor act, approved June 6, 1900.

July 1, 1899, balance unexpended		$48,660.30
Amount appropriated by sundry civil act approved June 6, 1900		280,000.00
Amount allotted from appropriation contained in emergency river and harbor act approved June 6, 1900		1,000.00
		329,660.30
June 30, 1900, amount expended during fiscal year		40,563.15
July 1, 1900, balance unexpended		289,097.15
July 1, 1900, outstanding liabilities		1,285.83
July 1, 1900, balance available		287,811.32
Amount (estimated) required for completion of existing project		4,395,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$210,000.00	
For maintenance of improvement	1,000.00	
		211,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix I I 10.)

11. Operating and care of lock and dam on Big Sandy River, West Virginia and Kentucky.—This lock and dam, located near Louisa, Ky., was finished during the fiscal year of 1897, under appropriations for improving Big Sandy River, West Virginia and Kentucky. Its efficiency as an aid to navigation is restricted to forming a pool in the river, since it is the only one yet built of the series.

The lock has a depth of 1 foot 9 inches over the lower sill at mean low water, and of 11 feet 9 inches over the upper sill at pool level. When the other dams of the series have been built the minimum depth at pool stage will be 6 feet. The lock is 52 feet wide and 190 feet long between hollow quoins. The navigable pass is 130 feet wide.

The project involves operating and caring for the lock and dam with such funds as may annually be allotted.

The amount expended for this purpose to June 30, 1899, was $5,168.34, the work having continued since July 1, 1897.

On June 30, 1899, the work was in good condition and available for commerce.

The expenditures during the fiscal year ending June 30, 1900, have been $3,615.94, and have resulted in protecting a portion of the bank, in making certain incidental repairs, and in operating and caring for the lock, dam, and appurtenances.

Commercial statistics for this work are given in the report for improving Big Sandy River.

(See Appendix I I 11.)

12. Tug Fork of Big Sandg River, West Virginia and Kentucky.—In its original condition this stream was much obstructed by rocks, snags, logs, and overhanging trees.

The original project, adopted in 1880, for improving Big Sandy River and its forks (Annual Report of the Chief of Engineers for 1875, pp. 756–769), provided for removing the natural obstructions in the stream and the construction of low wing dams of loose stones at shoal places, so as to aid the floating of timber and light-draft steamboat navigation.

The present project, submitted April 27, 1898, contemplates extending slack water up the Tug Fork to the mouth of Pond Creek as part of the improvement of the Big Sandy River.

Until 1890 there was no separation in the appropriations for the Big Sandy River and its forks. Since that year the appropriations have been made separately for the main river and Tug and Levisa forks.

Reckoning from the time of separation of the appropriations to June 30, 1899, the total amount spent on Tug Fork amounts to $27,733.89. This expenditure has resulted in the material improvement of navigation, giving increased facilities for push boats at low water, and rafting and light-draft steamboats at moderate stages, for the distance of 100 miles upstream from Louisa, Ky.

During the fiscal year field work under the original project has been carried on with the appropriation of March 3, 1899, the channel having been cleared of rocks, snags, etc., over a distance of 60 miles.

Under the modified project for extending slack water up the forks, a survey was continued, which is reported under the head of improving Big Sandy River.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the improvement was about 20 inches.

The commerce for the last three years has been:

Calendar year—	Tons.
1897	135,000
1898	130,400
1899	128,200

No material increase can be hoped for until the slack-water system has been carried up the fork some distance above Louisa.

July 1, 1899, balance unexpended	$1,516.11
June 30, 1900, amount expended during fiscal year	1,488.96
July 1, 1900, balance unexpended	27.15
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix I I 12.)

13. Levisa Fork of Big Sandy River, Kentucky.—In its original condition this stream was much obstructed by rocks, snags, logs, and overhanging trees.

The original project, adopted in 1880, for improving Big Sandy River and its forks (Annual Report of the Chief of Engineers for 1875, pp. 756–769) provided for removing the natural obstructions in the stream and the construction of low wing dams of loose stones at shoal places, so as to aid the floating of timber and light-draft steamboat navigation.

The present project, submitted April 27, 1898, contemplates extending slack water up the Levisa Fork to Pikeville as part of the improvement of the Big Sandy River.

Until 1890 there was no separation in the appropriations for the Big Sandy River and its forks. Since that year the appropriations have been made separately for the main river and Tug and Levisa forks.

Reckoning from the time of separation of the appropriations to June

30, 1899, the total amount spent on Levisa Fork amounts to $26,724.43. This expenditure has resulted in the material improvement of navigation, giving increased facilities for push boats at low water, and rafting and light-draft steamboats at moderate stages.

During the fiscal year field work under the original project has been carried on with the appropriation of March 3, 1899, the channel having been cleared of snags, rocks, etc., over a distance of 68 miles.

An allotment of $1,000 for snagging was made July 7, 1900, from the appropriation contained in the emergency river and harbor act approved June 6, 1900.

Under the modified project for extending slack water up the forks, a survey was continued, which is reported under the head of improving Big Sandy River.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the improvement, was about 20 inches.

The commerce for the last three years has been:

Calendar year—	Tons.
1897	220, 800
1898	211, 300
1899	158, 250

No material increase can be hoped for until the slack-water system has been carried up the fork some distance above Louisa.

July 1, 1899, balance unexpended	$1, 025. 57
Amount allotted from appropriation contained in emergency river and harbor act approved June 6, 1900	1, 000. 00
	2, 025. 57
June 30, 1900, amount expended during fiscal year	955. 16
July 1, 1900, balance unexpended	1, 070. 41
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix I I 13.)

14. Kentucky River, Kentucky.—At the time the project was adopted in 1879, the five locks and dams built by the State of Kentucky many years ago were in a dilapidated condition and had been practically abandoned and allowed to go to ruin. The channel was also much obstructed by snags and leaning trees. Portions of Dams Nos. 1 and 2, on the lower part of the stream, were gone entirely, so that navigation was suspended.

The original and present project was adopted in 1879 (Annual Report of the Chief of Engineers for 1879, pp. 1398–1422) and provided for repairing and rebuilding the five old locks and dams, removing snags, logs, and other obstructions, and extending 6-foot slack-water navigation up the stream to Three Forks, a distance of about 261 miles from the mouth of the river in the Ohio, at Carrollton, Ky.

The amount expended to June 30, 1899, was $1,822,771.14. The result of this expenditure was the repairing and rebuilding of five old locks and dams constructed by the State of Kentucky, the construction and completion of Lock and Dam No. 6, the practical completion of No. 7, the beginning of No. 8, and the construction of a dam at Beattyville.

The greatest draft which could be carried at mean low water throughout the slack-water system from Lock No. 1 to Little Hickman, 139.8 miles from the mouth, was 5.34 feet. A rock ledge at the entrance to Lock No. 2 is the shallowest point. Elsewhere the depth is 6 feet or more.

Ordinary low-water depth through Lock No. 1 and to the Ohio River, 4 miles below, is 6 feet or more; but at extreme low water only about 2½ feet can be carried over the lower sill of Lock No. 1.

The old Locks Nos. 1 to 5, inclusive, built by the State have 145 feet available length and 38 feet width, and can pass coal barges only singly. Locks Nos. 6 and 7, built by the United States, have 148 feet available length and 52 feet width, and can pass two coal barges at each lockage.

The expenditure during the year ending June 30, 1900, has resulted in building coal bins at two of the locks, finishing the cribs and a culvert at No. 7, nearly finishing the masonry and cribs at No. 8, clearing the pool of No. 8 of overhanging trees, selecting the site of No. 9 and preparing the papers for its purchase and condemnation, and in certain surveys and miscellaneous work.

The availability for commerce remains the same as at the close of the last fiscal year. The maximum draft at mean low water which can be carried over the shoalest part of the slack-water system is 5.34 feet. Above the slack-water system no boats can run at a low stage.

The cost of the complete improvement will exceed by a large sum the limit of authority for continuing contracts granted by existing legislation, as stated in the Annual Report of the Chief of Engineers for 1899, page 2514. This limit will probably be reached while the last four locks and dams are still untouched or incomplete. With the existing balance it is proposed to complete Lock and Dam No. 8; purchase sites for Nos. 9, 10, 11, and 12; make plans for Nos. 9, 10, and 11; build lock keepers' houses at Nos. 9 and 10, and commence construction of Nos. 9 and 10. With the amount asked for the fiscal year ending June 30, 1902, it is proposed to complete Lock and Dam No. 9, continue work on No. 10, build lock houses at No. 11, and make preliminary arrangements for work at Nos. 11 and 12.

Commercial statistics for the river are given in the report for operating and care of locks and dams on Kentucky River. The greatest total of shipping passing any lock was 203,237 tons.

July 1, 1899, balance unexpended		$483,723.06
Amount collected from bondsmen of O'Brien & Gulden, failing contractors, January 4, 1893		6,000.00
Amount appropriated by sundry civil act approved June 6, 1900		75,000.00
		564,723.06
June 30, 1900, amount expended during fiscal year		173,131.23
July 1, 1900, balance unexpended		391,591.83
July 1, 1900, outstanding liabilities	$833.08	
July 1, 1900, amount covered by uncompleted contracts	68,929.69	
		69,762.77
July 1, 1900, balance available		321,829.06
Amount (estimated) required for completion of existing project		2,485,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix I I 14.)

15. Operating and care of locks and dams on Kentucky River, Kentucky.—At the time the United States acquired possession of the five locks and dams on this stream in 1880 navigation was practically suspended on account of the fact that the works required repairing and rebuilding. These five locks and dams were built by the State of Kentucky in 1835–1839, and from 1880 up to 1885 were extensively repaired by the United States under appropriations for improving Kentucky River, Kentucky. Since then Locks and Dams Nos. 6 and 7 have been built and added to the system, and No. 8 is now under construction and nearly finished.

As these locks and dams have been opened to navigation, the maintenance has devolved upon the indefinite appropriation of July 5, 1884, for operating and care of canals and other works of navigation.

At present 7 locks and dams are so maintained. Eventually, if the plan of improvement be completed, there will be 14 in operation.

The work is done by hired labor under projects and estimates submitted annually.

The total expended up to June 30, 1899, was $751,246.09. With this sum the system has been maintained since the first allotment in 1885, there being at first 5 and now 7 locks in operation. The annual expenses have therefore averaged about $50,000. When the entire system of 14 locks is to be provided for, the annual charges will probably be considerably greater than this amount.

At the end of the last fiscal year the system was in good navigable condition for boats small enough to pass the locks. Some repairs were necessary.

The amount expended during the fiscal year ending June 30, 1900, was $58,726.97. With this sum the locks have been operated and the channels maintained in navigable condition.

Practically all the repairs projected for the year were finished. The machinery for a new dredge has been ordered, and will be supplied during the coming season.

On June 30, 1900, the system was in good navigable condition, but many parts are nearly worn out and must soon be renewed.

The maximum draft which can be carried over the shoalest part of the slack-water system at pool level is 5.34 feet. At dead low water boats can carry only about 2¼ feet out of the Kentucky into the Ohio.

The commerce, in tons of freight, at the different locks for the last three years has been as follows:

Lock.	Fiscal year 1897.	Calendar year 1898.	Calendar year 1899.
	Tons.	*Tons.*	*Tons.*
No. 1	54,499	172,862	203,237
No. 2	46,028	169,060	187,580
No. 3	35,008	128,847	159,482
No. 4	37,247	130,613	158,351
No. 5	70,343	111,939	182,956
No. 6	69,822	94,970	121,628
No. 7	....	108,825	127,000
Average	52,157	131,017	162,891

(See Appendix I I 15.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and survey of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. Harry F. Hodges, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers:

1. *Preliminary examination of Elk River, West Virginia, from its mouth to Sutton.*—Captain Hodges submitted report September 25, 1899. In his opinion, concurred in by the division engineer and by me, the river is not worthy of any further improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 70, Fifty-sixth Congress, first session. (See also Appendix I I 16.)

2. *Preliminary examination of Guyandot River, West Virginia.*—Captain Hodges submitted report September 13, 1899. In his opinion the river is not worthy of further improvement by the General Government except to maintain the present channel free from obstructions, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 64, Fifty-sixth Congress, first session. (See also Appendix I I 17.)

3. *Survey of Big Sandy River, West Virginia and Kentucky, including Levisa and Tug forks.*—Captain Hodges submitted preliminary report January 10, 1900. The estimated cost of improvement proposed is $4,725,000. Final report is in preparation, and if possible will be submitted in time for transmission to Congress at its next session. The preliminary report was transmitted to Congress and printed in House Doc. No. 326, Fifty-sixth Congress, first session. (See also Appendix I I 18.)

IMPROVEMENT OF FALLS OF OHIO RIVER, OF WABASH RIVER, INDIANA AND ILLINOIS, OF WHITE RIVER, INDIANA, AND OF CERTAIN RIVERS IN KENTUCKY.

This district was in the charge of Capt. Geo. A. Zinn, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Falls of the Ohio River at Louisville, Ky.*—Previous to June 4, 1897, the work of improving the falls of the Ohio River was carried on under two heads, each provided for under separate appropriations or allotments, one for the work of enlarging the upper end of the Louisville and Portland Canal, and the other for excavation and structures in the main channel over the falls, known as the Indiana Chute. By the sundry civil act of June 4, 1897, the two divisions of the project were combined.

Before the adoption of the original project in 1883 the approach to the canal and its upper end above the railroad bridge was so narrow as to be a source of constant delay to the large coal fleets which came down the river on ordinary rises. The canal proper, from Ninth to Fourteenth streets, was only 100 feet wide, and curved between the two points, making progress slow and liability to accident frequent and unavoidable. The greater part of the dike making the north line of the approach was submerged when the river reached a stage of 8.4 feet, upper canal gauge, and at 9 feet and above a strong cross current was created by which many vessels were pulled against the structure, and at high water carried over it to the rock ledges. This approach was 1,800 feet long, 400 feet wide at its upper end, and 100 feet wide at the mouth of the canal opposite Ninth street. This area did not provide sufficient room for making up or breaking tows preparatory to leaving or entering the canal, and caused much delay to traffic, and often resulted in considerable additional expense by reason of the fact that tows arriving on a falling stage, and at one too low to continue via the Indiana Chute, were unable to get the boats through the locks in time to continue the journey before the water reached a stage too low to float the loaded craft, thus compelling them to lie over and wait for another rise to occur, which involved harboring the boats and consequent expenses.

The projects under which work has been and is now carried on are as follows: The original, adopted in 1883, and slightly modified in 1885, which provided for the enlargement of the canal from its mouth to a point below the railroad bridge, and a large harbor or basin above the mouth; that approved January 31, 1890, after having been considered and submitted by a Board of Engineer Officers convened for that purpose, which included work and structures at the head of the canal and in the Indiana Chute, to provide a navigable channel through the latter when the stage of the river is at or above 8 feet upper canal gauge. A revision of the latter project, submitted by a Board of Engineer Officers and approved April 8, 1899, modified the area to be excavated and determined definitely the character of the structures to be erected in the enlargement at the head of the canal. That portion of the project pertaining particularly to the enlargement of the easterly end of the canal provides for enlarging the canal on its northerly side, from a point 725 feet below the railroad bridge near Fourteenth street, where the canal is abruptly increased from 90 to 210 feet in width. This latter width is gradually increased through a distance of nearly 2,800 feet to 325 feet at the head of the canal proper, at which point the enlargement is expanded into a capacious basin 1,200 feet wide, and practically parallel to the Kentucky shore. Along the western line of this basin a movable dam is provided, which will hold the river at stages of 8 feet and less, and serve as a sluice for carrying away mud and deposit at stages greater than 8 feet. The dam on the north line of the basin, connecting one end of the movable dam with the present cross dam at the south abutment of the Middle Chute, is built of concrete, with its crest at 8 feet upper canal gauge, practically eliminating the dangerous cross currents near the Kentucky shore, and providing a basin with ample accommodations for the movement of vessels and tows approaching the canal.

At the beginning of the fiscal year 1899 the enlargement south of the new canal wall and west of Ninth street was practically completed, there being only about 50 cubic yards rock (loose) adjacent to the west fender pier of the Fourteenth Street Bridge remaining to be removed. The greater part of the area west of the cross dam, comprising the proposed basin above the new mouth of the canal, had been excavated to grade, and preparatory work had been started on the concrete and Boulé dams. A small amount of drilling east of the cross dam had been done.

During the fiscal year ending June 30, 1900, the concrete and Boulé dams were completed. The earth and rock excavation on old section

3 were practically finished. The guiding dike and cross dam were removed, with the exception of the abutment at the north end of the latter and about 110 feet at the east end of the former. Two drilling plants, operated by compressed air, were engaged in drilling the area east of the cross dam, the ledges under the cross dam and guiding dike, and the area east of the Boulé dam. The work remaining to be done June 30, 1900, consists of the completion of the rock excavation east of the cross dam and that under the former cross dam and guiding dike, and the removal of the remaining parts of these structures; earth and rock excavation, a new wall and stone revetment on the south side of the canal west of Tenth street to a point about 412 feet east of the Fourteenth Street Bridge; the removal of the old wall and guard-gate abutment on the south side of the canal near Tenth street, and the excavation of a channel through the rock ledge below the new locks.

The main channel of the river, by which commerce passes the falls when the stage of the river is such as to permit navigation over them, is known as Indiana Chute. Originally it was very crooked, with swift currents and whirls, filled with dangerous, rocky points projecting from the sides and bottom, and navigable by skilled pilots only, when the river was up to or above 11 feet on the upper gauge of the Louisville and Portland Canal. About half the distance down was an abrupt turn flanked by two projecting points of rock, the one on the south, a part of Goose Island, known as Wave Rock, the other on the north and slightly west, a part of the Indiana shore, called Willow Point. The channel around and between these points was tortuous, the current swift, and navigation dangerous, except at very high stages of water.

Prior to January 31, 1890, there was no specific project for the improvement of the Indiana Chute. The work was carried on with allotments from appropriations for improving Ohio River, and under projects having in view the removal of projecting rocks and straightening the channel between the cross dam and railroad bridge, but no definite limits were prescribed within which work was to be done.

The work previous to the adoption of the definite project resulted in increasing the safe width of the channel between the cross dam and railroad bridge from 60 to 250 feet, and the removal of a large mass of reefs just below the bridge, known as Rubels Rock. The project of January 31, 1890, is not materially changed by the revision approved April 8, 1899. The general object is to make the chute safely navigable for descending traffic when the stage of the river is at or above 8 feet, upper canal gauge, by providing a good channel 400 feet wide between the cross dam and railroad bridge. The top of Wave Rock is to be excavated to ref. 22 and of Willow Point to ref. 19. Below Willow Point a stone dike 1,250 feet long, and below Wave Rock a similar structure 2,300 feet long, curving downstream, will fix the navigable channel at a width of about 700 feet. These dikes are also intended to reduce the area of discharge of the chute so as to maintain the 8-foot depth over Wave Rock and Willow Point as long as that depth exists in the channel at the head.

The condition of the Indiana Chute at the close of the fiscal year 1899 was as follows: In the section above the railroad bridge the channel had been excavated to grade, 400 feet wide, for a distance of 752 feet below the cross dam. At Willow Point the stone dike had been completed and there had been removed 21,227 cubic yards (loose) from the point. At Wave Rock about 400 feet of the base of the dike had been built, and 12,867 cubic yards (loose) had been removed.

The work accomplished during the fiscal year ending June 30, 1900, was as follows: Between the cross dam and railroad bridge excavation was carried to grade, so as to have the channel completed 400 feet wide for a distance of 1,252 feet below the cross dam, and from the latter point 350 feet wide to the railroad bridge. At Willow Point 16,242.94 cubic yards (loose) of rock were removed and placed in a storage dump behind the stone dike. At Wave Rock the excavation amounted to 26,083.07 cubic yards (loose), which was placed in the base of the dike and in necessary roads leading thereto. The base of the dike, 35 feet wide on top, was finished to subgrade, with the exception of 168 feet near the lower end. The excavation at Willow Point gives an additional width of about 50 feet, and that at Wave Rock of about 40 feet.

The amount expended on the combined project up to the close of the fiscal year ending June, 30, 1899, was $1,217,417.93. Statistics showing the quantity and character of commerce passing through the canal and over the falls may be seen by reference to the report of operating and care of Louisville and Portland Canal.

July 1, 1899, balance unexpended	$309,832.07
June 30, 1900, amount expended during fiscal year	170,014.82
July 1, 1900, balance unexpended	139,817.25
July 1, 1900, outstanding liabilities	10,158.65
July 1, 1900, balance available	129,658.60
Amount (estimated) required for completion of existing project	41,091.58
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	41,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 1.)

2. *Operating and care of Louisville and Portland Canal.*—The present work is the outgrowth of the construction of the canal by a private corporation in 1830, and its transfer to the United States in 1874 by the authority of Congress. The canal is about 2 miles long and 90 feet wide below the enlargement at the head. There are two new masonry locks in flight, the chambers of each being 350 feet long and 80 feet wide.

The annual estimates and projects have provided for operation and maintenance in good navigable condition, together with such special work as may from time to time be found necessary to make it sufficient to meet the demands of navigation and commerce.

Expenditures from July 1, 1880, when tolls were abolished and the canal became a direct charge on the Treasury, to June 30, 1899, amounted to $1,416,459.62, not including outstanding liabilities.

The canal is available to commerce at all stages of water less than 12.7 feet, upper gauge, and serves its purpose by permitting free navigation around the Falls of the Ohio River at stages of water when the passage can not be made by the open river channel.

During the fiscal year ending June 30, 1900, expenditures amounted to $92,273.51.

During the fiscal year ending June 30, 1900, 5,723 boats, barges, and small craft passed through the canal; the tonnage of these amounted to

1,289,332, and they carried 1,326,717 tons of freight and 11,517 passengers. The annual average for the past nineteen years of traffic and commerce passing this place via canal and open river is as follows: Boats, 6,715; tonnage, 1,841,106; freight average for fourteen years, 1,978,510 tons.

(See Appendix J J 2.)

3. Wabash River, Indiana and Illinois.—In its original condition this river was badly obstructed with shoal bars, accumulations of snags, rocky reefs, and numerous secondary channels or cut-offs, which lessened the flow of water through the main channel, and navigation was impossible except at high stages of water.

The original project, submitted in 1872, provided for special improvements at twelve designated points, and a general improvement of the river from its mouth to Lafayette, Ind., by means of light-draft boats and dredges, and until March 3, 1881, appropriations were applicable to this whole stretch of river. The act of Congress of that date separated the river into two sections, with Vincennes, Ind., as the dividing point. Since then specific appropriations have been made for each section, otherwise the project has never been amended or revised, notwithstanding the fact that with existing conditions neither it nor the original estimates are applicable or adequate to a systematic improvement of the river.

From the commencement of the work in 1872 to March 31, 1881, the expenditures, all of which were for work below Vincennes, amounted to $324,845.44. Since March, 1881, expenditures for each section of the river are given below separately.

Below Vincennes.—From March, 1881, to June 30, 1899, expenditures for work below Vincennes amounted to $369,808.42, including $25,000 expended for levee work at Grayville, Ill.

Since 1884 the greater part of the appropriations for the section below Vincennes has been applied to the construction of a masonry lock and timber dam, with masonry abutments and timber guide cribs, at Grand Rapids. The lock, dam, abutments, and guide cribs have been completed, and since March, 1897, the expenses of operating and care of these structures have been paid from the indefinite appropriation for operating and care of canals and other works of navigation.

Since the operations and funds have been concentrated to complete the structures just mentioned, and necessarily suspended elsewhere on the river, the improvements at other places have rotted away or been damaged by ice and freshets. High water has cut its way around them, leaving the river as badly obstructed as it was before its improvement was commenced, and with no improvement to its navigation and commerce other than the channels cut through solid rock, and the lock and dam at Grand Rapids, which latter will be of little benefit unless the river is improved in such manner as to enable boats to reach that point.

Therefore, considered as an entirety, this section of the river at a normal stage is not available for navigation. The obstructions now existing present no unusual features to indicate that they would be difficult to overcome, and with sufficient funds for regular and continuous operations the river could be easily adapted to the requirements of commerce. The improvements, however, should begin at the mouth of the river and be carried continuously upstream. No work has been done on this section of the river during the year.

The river and harbor act of March 3, 1899, appropriated $15,000 for work below Vincennes. This amount is too small for the completion of work proposed at New Harmony Cut-off in one working season, and on account of the danger of destruction of incomplete work it was deemed advisable to reserve the money available until further appropriation shall have increased the amount to a sum adequate for completion in one season.

The only commercial statistics available are those collected at the lock at Grand Rapids and given in the report for that work.

There is in existence no approved project, with estimate, which adequately provides for the systematic improvement of Wabash River from its mouth to Mount Carmel, Ill., and as a prerequisite to the preparation of such a project a detailed survey of this portion of the river is necessary. Such survey would cost about $20,000. The lock and dam at Grand Rapids is of little value to commerce unless the river is navigable from its mouth to the lock.

July 1, 1899, balance unexpended	$15,346.14
July 1, 1900, balance unexpended	15,346.14
July 1, 1900, outstanding liabilities	25.75
July 1, 1900, balance available	15,320.39
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Above Vincennes.—Since this part of the river became the object of specific appropriations, the sum of $91,161.30 had been expended to June 30, 1899. Formerly a good channel 3 feet in depth was maintained, but for several years past the appropriations have been too small to permit of other than snagging operations at irregular intervals. The channel at present is available for navigation only at high stages of water. At low water the numerous snags, bars, and secondary channels render navigation, even with boats of the lightest draft, extremely uncertain. No regular line of steamboats operates upon this section of the river. The only traffic is carried on during high stages of water, when a few light-draft boats make irregular trips to transport corn, wheat, oats, and similar commodities to the nearest railway for shipment. Snagging operations on that portion of the river between the crossing of the Indiana and Illinois Southern Railroad and Blacks Bend, a distance of 13 miles, were carried on when the stage of the river permitted, between July 22 and September 9, 1899. Similar work is contemplated during the coming season with the funds available.

July 1, 1899, balance unexpended	$4,338.70
June 30, 1900, amount expended during fiscal year	1,914.37
July 1, 1900, balance unexpended	2,424.33

(See Appendix J J 3.)

4. Operating and care of lock and dam at Grand Rapids, Wabash River.—This lock and dam were built from funds derived from appropriations for improving Wabash River, Indiana and Illinois. The operating expenses were also paid from that appropriation until March 1, 1897, since which date they have been paid from allotments from the indefinite appropriation for operating and care of canals and other works of navigation, act of July 5, 1884. The annual projects and estimates provide for the lock's operation and such repairs thereto and the appurtenant structures as may be necessary to maintain them in good condition. From March 1, 1897, to June 30, 1899, the expenditures amounted to $2,011.52.

The expenditures during the fiscal year ending June 30, 1900, amounted to $6,640.69, which were for lock-tender's salary, repairs, material for new gates, cleaning out mud from lock chambers and upper entrance, a small protection crib on the abutment side of the river, and work in connection with placing the new gates.

A synopsis of traffic through the lock is as follows:

During fiscal year 1900: Boats, etc., 238; tonnage, 7,477; freight, 6,419 tons. Average for four fiscal years: Boats, 283; tonnage, 7,358; freight, 3,559.

(See Appendix J J 4.)

5. *White River, Indiana.*—Originally this river was, throughout the entire reach embraced within the project, badly obstructed by rock reefs, shoals, remains of old structures, and a very great number of snags. It could be navigated only during high stages of water.

The original project is based upon the report of examinations of the White River and its forks in Indiana, submitted December 31, 1878, and the first provision for improvement was made in the river and harbor act of March 3, 1879. The object was to provide a channel as far as might be practicable without constructing locks and dams. A depth of 2 feet is indicated, but no minimum width or depth of channel was specified. In this project, which has not up to this time been amended or revised, the estimated cost was $150,000. The act of August 18, 1894, provided for a resurvey of the river. For detailed report of this survey and estimate of cost of improvements, together with recommendations, see pages 2483–2504 of the Annual Report of the Chief of Engineers for 1897.

The funds available were not sufficient for any operations during the past year. The total expenditures to June 30, 1899, were $119,296.18. The lower 13 miles of the river are navigable for boats drawing 3 feet; above this to the junction of the two forks and about 5 miles up East Fork boats drawing 18 inches can navigate about one month in the year.

July 1, 1899, balance unexpended	$703.82
July 1, 1900, balance unexpended	703.82

(See Appendix J J 5.)

6. *Lock No. 2, Green River, at Rumsey, Ky.*—This lock was originally built by the State of Kentucky and was acquired by the United States with other locks and dams on Green and Barren rivers, Kentucky, December 11, 1888. The lock was then in a dilapidated and dangerous condition. The deficiency act, approved March 3, 1893, appropriated $65,000 for rebuilding this lock, which in 1892 was reported unsafe for navigation. The project for the work, approved in 1893, provided for the construction of a new lock, on the river side of the old lock, with certain changes of existing conditions to make them conform to the new location. The amount expended to June 30, 1899, was $167,739.06. The new lock, with guide cribs, a spur dike to cut off a cross current from the lower entrance of the lock, and the grading, have been finished. No work was done during the fiscal year. The lower entrance remains to be straightened by blasting along a

slate ledge, and the walks through the grounds are to be paved. The funds now available are sufficient to complete the work remaining to be done under the project, and it is expected that such work will be done during the next fiscal year.

July 1, 1899, balance unexpended	$2,260.94
July 1, 1900, balance unexpended	2,260.94

(See Appendix J J 6.)

7. *Green River above the mouth of Big Barren River, Kentucky.*—Lock and Dam No. 5 is about 3,400 feet below the mouth of Bear Creek and 18 miles above Lock No. 4. The original project for the improvement of the river above the slack water afforded by Lock No. 4 is contained in the report submitted under date of August 11, 1891 (printed in the Annual Report of the Chief of Engineers for 1891, p. 2481). It provides for slack-water navigation from the upper line of pool No. 4 to Mammoth Cave by the construction of two locks and dams, the combined lift of both aggregating 27 feet, at an estimated cost of $361,346.40. The act of July 13, 1892, provided for the construction of Lock No. 5, and the operations have since been limited to the building of that structure. Concrete was substituted for stone for lock walls under authority dated February 27, 1897. The amount expended to June 30, 1899, was $84,624.43, at which time there had been completed the concrete masonry for the land wall, the foundation of the lock, and a lock-tender's house. Preparations were in progress for resuming construction with funds provided by the river and harbor act of March 3, 1899.

During the fiscal year ending June 30, 1900, the following work was accomplished: The construction of the river wall, miter and breast walls, the abutment, the lock gates and operating machinery, the dam, the upper and lower guide cribs, the protection of the banks above and below the abutment, and the clearing of the pool above the lock from all obstructions. The lock was opened to navigation January 17, 1900. The work remaining to be done consists in further protection of the banks, grading the grounds, erecting a second lock-tender's dwelling, and minor improvements on the grounds.

Lock No. 6, estimated to cost $180,673.20, is a part of the originally adopted project, and no appropriations for the construction of the same have been made. Report of August 7, 1899, on preliminary examination of Green River from Mammoth Cave to Greensburg, printed in House Doc. No. 103, Fifty-sixth Congress, first session (also submitted as Appendix J J 11 of this report), assumes that the construction of Lock No. 6 is a part of the project for improving Green River, Kentucky, above the mouth of Big Barren River to Mammoth Cave, Ky. For this reason an estimate of $90,000 is submitted with a view to beginning construction of this lock.

July 1, 1899, balance unexpended	$96,048.77
June 30, 1900, amount expended during fiscal year	89,746.84
July 1, 1900, balance unexpended	6,301.93
July 1, 1900, outstanding liabilities	582.26
July 1, 1900, balance available	5,719.67
Amount (estimated) required for completion of existing project	180,673.20
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	90,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 7.)

8. *Operating and care of locks and dams on Green and Barren rivers, Kentucky.*—The United States acquired possession of the five locks and dams on Green and Barren rivers on December 11, 1888, by purchase of the unexpired lease of the Green and Barren River Navigation Company, the legislature of the State of Kentucky having ceded them, with land and appurtenances pertaining thereto, to the United States, upon condition that the latter should extinguish the claim of the navigation company to take tolls and to exercise control over the rivers.

At the time of the transfer the river wall of Lock No. 3, Green River, had fallen into the river; the lower end of the land wall of Lock No. 1, Barren River, was badly cracked and liable to fall at any time, and both walls of Lock No. 2, Green River, were in a dangerous condition. The channel of the river was much obstructed by snags and slides.

Since the United States acquired control of the locks and dams navigation throughout the entire system has been restored by either extensive repairs or new work. The expenditures for repairs, operations, and maintenance to June 30, 1899, aggregated $769,007.53. During the fiscal year ending June 30, 1900, the expenditures amounted to $71,025.25, which were for the operation and maintenance of the several locks and dams and for necessary repairs to houses and property, including new lower gates, beginning repairs to lower shore crib, upper river approach, addition to abutment, crib and bank protection at Lock No. 3, Green River; guide and protection cribs, bank protection, and new wing crib at Lock No. 1, Green River; new paving at Lock No. 4, Green River, and bank protection at Lock No. 1, Barren River.

Following is a synopsis of traffic through the locks:

During fiscal year 1900.

	Boats.		Freight.
	No.	*Tonnage.*	*Tons.*
Green River:			
Lock No. 1	2,940	328,337	378,684
Lock No. 2	2,710	312,368	288,948
Lock No. 3	1,891	231,344	172,016
Lock No. 4	2,288	261,332	139,530
Lock No. 5[a]	616	51,695	47,098
Lock No. 1, Barren River	1,386	139,636	33,355

Average for three past fiscal years.

Green River:			
Lock No. 1	2,733	280,591	276,424
Lock No. 2	2,485	268,314	205,668
Lock No. 3	1,806	216,061	121,752
Lock No. 4	2,260	237,223	89,316
Lock No. 5[a]	616	51,695	47,098
Lock No. 1, Barren River	1,430	139,540	34,844

[a] Opened to navigation Jan. 17, 1900.

(See Appendix J J 8.)

9. *Rough River, Kentucky.*—Originally this river was very much obstructed by snags, sunken logs, and bowlders in the bed, and by overhanging trees on the banks. Backwater from Rumsey Dam No. 2, on Green River, affected the lower 8 miles of the river, but above that distance the stream was very shallow at low water.

The project for the improvement, adopted in 1890, provided for the clearing of the river of obstructions and for the location and construction of a lock and dam, so as to carry slack water to Hartford, Ky., for boats not exceeding 123 feet in length, 27 feet in width, and 4 feet draft.

Expenditures to June 30, 1899, amounted to $95,877.19.

The lock and dam have been completed and are available for navigation.

The only work done during the year consisted in the erection of a lock-tender's house, placing a combstick on the dam, grading the grounds adjacent to the lock, and miscellaneous repairs.

The funds now available are sufficient to complete the work remaining to be done under the project, consisting of a small amount of bank protection in the vicinity of the lock, and to keep the improved portions of the river clear of obstructions during the next fiscal year.

Traffic through the lock during the past year included 770 boats, crafts, and rafts of various kinds, with an aggregate tonnage of 14,350, and carrying 41,411 tons of freight.

Annual averages for the past three years are as follows: Boats, 595; tonnage, 10,896; freight, 26,243 tons.

July 1, 1899, balance unexpended	$9,622.81
June 30, 1900, amount expended during fiscal year	3,539.84
July 1, 1900, balance unexpended	6,082.97
July 1, 1900, outstanding liabilities	171.15
July 1, 1900, balance available	5,911.82

(See Appendix J J 9.)

10. *Operating and care of lock and dam on Rough River, Kentucky.*—This lock and dam were built from funds provided in appropriations for improving Rough River, Kentucky, and were opened to navigation December 12, 1896. The expenses of their operation and care since July 1, 1897, have been paid from the indefinite appropriation for operating and care of canals and other works of navigation, act of July 5, 1884. The total expenditures for this purpose up to June 30, 1899, were $1,598.47.

The project and estimate for the past year provided for nothing further than the operation and care of the lock and current repairs incident thereto. The expenditures for these purposes during the year amounted to $684.41. The lock affords slack-water navigation to Hartford, Ky.

(See Appendix J J 10.)

EXAMINATION OF GREEN RIVER, KENTUCKY, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination of *Green River, Kentucky, from Mammoth Cave, to Greensburg*, required by the river and harbor act of March 3, 1899, was made by the local engineer, Capt. Geo. A. Zinn, Corps of Engineers, and report thereon submitted through the Division Engineer, Col. Henry M. Robert, Corps of Engineers. He does not recommend improvement of the river between the limits mentioned, other than snagging operations between Mammoth Cave and Munfordville at an estimated cost of $27,000 and about $2,500 annually for maintenance. His views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 103, Fifty-sixth Congress, first session. (See also Appendix J J 11.)

EXAMINATION OF OHIO RIVER (IN KENTUCKY), REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Ohio River (in Kentucky), with a view to ascertaining the desirability of acquiring the island immediately below the Louisville and Portland Canal in the Ohio River, known as Sand Island, and probable cost of purchasing the same*, required by the emergency river and harbor act of June 6, 1900, and report thereon will be transmitted to Congress at its next session.

LAKE RIVERS AND HARBORS.

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE SUPERIOR.

This district was in the charge of Maj. Clinton B. Sears, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Harbor at Grand Marais, Minn.—This small natural basin was not originally of sufficient depth, nor was it adequately sheltered, either for commercial purposes or for use as a harbor of refuge. The approved project of 1879 proposed two breakwater piers, each 350 feet long, from the east and west points of the bay, or one pier 700 feet long from the east point, and the dredging to a depth to accommodate the prevailing draft of vessels, which was 14 feet. The original estimated cost was $139,669.40, but for reasons explained in the report of the local officer (Annual Report of the Chief of Engineers for 1898 p. 2217) this was increased to $163,954.63. Up to the close of the fiscal year ending June 30, 1899, there had been expended on this work $132,802.44. With this sum 350 feet of the east pier had been completed and the 16-foot anchorage area increased to 26 acres. The increment of commerce which has accrued since the improvement of this harbor began bears the ratio of 25 entrances and clearances (made by 4 tugs and 5 schooners), with 60 tons of cargo, valued at $6,000, in 1878 to 346 entrances and clearances (nearly all steamers), with 6,203 tons of cargo, valued at $454,360, in 1899. The improvement has cost $133,100.66. The value of the commerce of the harbor from 1878 to 1899, both inclusive, is roughly estimated at $1,600,000.

The act of March 3, 1899, appropriated $30,000 for completing improvement. With this it is proposed to build a breakwater 350 feet long from the western point and running out in a southeasterly direction.

The contract for this work has been awarded at $88.91 per linear foot of stone embankment and crib structure and timber superstructure, to be completed December 1, 1900. Work under this contract is now under way.

July 1, 1899, balance expended	$30,547.56
June 30, 1900, amount expended during fiscal year	298.22
July 1, 1900, balance unexpended	30,249.34
July 1, 1900, amount covered by uncompleted contracts	29,000.00
July 1, 1900, balance available	1,249.34

(See Appendix K K 1.)

2. Harbor at Agate Bay, Minnesota.—This harbor, 27 miles east of Duluth, is a shipping port for iron ore and is a harbor of refuge.

The project for the improvement was adopted in 1887 and contemplates the erection of two piers projecting from the headlands of the bay and inclosing about 109 acres of water area, natural depth of 20 feet or more. The eastern pier is to be 1,050 feet long and the western one 900 feet. Work upon the east pier was commenced in 1887, and at the close of work in November, 1898, besides the 750 feet of east pier built in 1891, there were completed 750 feet of west pier and 160 feet of rock embankment brought to the 20-foot level for foundation of the extension to said pier.

The act of March 3, 1899, appropriated $71,708 to complete the project for this harbor.

This will be expended in completing both piers, the easterly one to a total length of 1,050 feet and the westerly one to a total length of 900 feet, and in making necessary repairs to the old work. Work on these two extensions is now under way, to be completed by September 1, 1901.

The commerce of this harbor has increased from 236,000 cargo tons, valued at $524,800, in 1885, to 4,604,252 cargo tons, valued at $9,500,000, in 1899. The total valuation of the commerce of this port for fourteen years, 1885 to 1899, is roughly estimated at $40,000,000.

The arrivals and departures of vessels have increased from 174, with a registered tonnage of 295,800 tons, in 1885, to 2,466, with a registered tonnage of 7,151,000 tons, in 1899.

The amount expended to June 30, 1899, was $171,980.52.

July 1, 1899, balance unexpended		$72,227.48
June 30, 1900, amount expended during fiscal year		8,744.41
July 1, 1900, balance unexpended		63,483.07
July 1, 1900, outstanding liabilities	$815.94	
July 1, 1900, amount covered by uncompleted contracts	54,660.51	
		55.476.45
July 1, 1900, balance available		8,006.62

(See Appendix K K 2.)

3. *Harbor at Duluth, Minn., and Superior, Wis.*—Previous to the annual report of 1897 this harbor was reported on under the separate heads of Duluth, Minn., and Superior, Wis., respectively.

The act of June 3, 1896, unified these harbors under the above title, and provided for continuous contracts for its improvement to the amount of $3,080,553.

This harbor now consists of the Duluth Canal, the Wisconsin Entrance, Superior Bay, Allouez Bay, St. Louis Bay, and St. Louis River to the limits of the cities of Duluth and Superior, about 20 miles from the original natural entry, which, before improvement, was obstructed by shifting bars, with but 9 feet of water over them. The bays were broad expanses of shallow water, averaging only 8 or 9 feet, except along the channel through them, where the depth was greater but variable.

The project previous to the present one was for 16-foot navigation. This was practically completed July 1, 1897, and resulted in giving a good 16-foot navigation through the natural or Wisconsin entry; through the artificial Duluth Canal; over the Duluth Basin, of 104 acres; along and parallel to the dock lines of Duluth and Superior, in Superior and St. Louis bays, and up the St. Louis River to New Duluth, near the head of navigation of the river, with well-defined channels from 85 to 300 feet in width.

The amount expended thereupon up to the close of the fiscal year ending June 30, 1899, was $2,360,243.35, of which $812,060.35 was under present project. The improvement thus made is in excellent condition, and the expenditure has been amply justified by the immense commerce which it has readily accommodated.

The present project, authorized by the act of June 3, 1896, provides for the widening and deepening to 20 feet of existing channels; for a new 20-foot channel along Minnesota Point dock line; for new channels in Allouez Bay; for extensive turning and anchorage basins 20 feet deep at the junction of two or more channels; for widening the Duluth Canal, and for replacing with substantial structures of timber and monolithic concrete the piers at the Duluth Canal and the Wisconsin Entrance.

The contracts for dredging these channels and basins have now been in operation for three seasons, and up to June 30, 1900, 11,759,900 cubic yards has been excavated.

All the land necessary for the widening of the Duluth Canal has been acquired by deed of gift, purchase, or condemnation, at a cost of $53,919.05.

For the land at the Wisconsin entry, the mouth of the Nemadji River, and a marshy island in the St. Louis River, condemnation proceedings have been instituted in the United States courts. A small parcel of land at the end of Grassy Point, containing 4.6 acres, has been purchased for $1,610.

The substructure for the new south pier has been completed, and 70 per cent of that for the new north pier. All the footing blocks for the former have been placed and secured in position, and 116 blocks on the north pier. The monolithic concrete work on the south pier has been begun, and up to June 30, 1900, 32 blocks have been molded, completing 320 linear feet of superstructure.

At the Wisconsin Entry piers the strengthening of the foundations with heavy riprap has been completed. On February 20, 1900, after due advertisement, a contract was made for the delivery of 9,000 barrels of Portland cement for the superstructure of north pier, and on May 3, 1900, a contract for work on the concrete superstructure itself.

The sundry civil act of June 6, 1900, appropriated $793,187.50 for this harbor. This will be used in carrying out existing contracts.

The lake commerce of this port, Duluth-Superior, during the last season of navigation amounted to over $157,000,000, at a very conservative valuation, and since the beginning of improvement by the United States this commerce has amounted to $1,318,243,000.

July 1, 1899, balance unexpended		$745, 577. 65
Amount appropriated by sundry civil act approved June 6, 1900		793, 187. 50
		1, 538, 765. 15
June 30, 1900, amount expended during fiscal year		635, 974. 30
July 1, 1900, balance unexpended		902, 790. 85
July 1, 1900, outstanding liabilities	$101, 491. 04	
July 1, 1900, amount covered by uncompleted contracts	1, 258, 791. 30	
		1, 360, 282. 34
Amount (estimated) required for completion of existing project		779, 727. 50
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		320, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of June 4, 1897.		

(See Appendix K K 3.)

4. Harbor at Ashland, Wis.—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay, nor from the waves generated within the bay itself by storms.

The original project was for the construction of a pile, slab, and rock breakwater 8,000 feet long and for dredging a channel in front of the wharves of the city. The act of March 3, 1899, added to this project by authorizing an extension of the breakwater to the shore, thus requiring the ultimate construction of 10,200 feet of breakwater. The act of June 6, 1900, provided for building a shore spur 4,700 feet in length from a point 2,600 feet east of the prolongation of the present breakwater and parallel thereto. This again changed the project, adding greatly to the total length of breakwater to be construeted and largely to the total expense. As a contract for the extension to the shore in a direct line had already been made, and about 91 feet of the same constructed at the time of the passage of this act, the change to the new site thus made obligatory by law necessitated the abandonment of this short piece and a change in the contractor's plans involving considerable expense.

The act of March 3, 1899, appropriated $35,000 for continuing the improvement, of which $10,000 has been expended in repairs to the old work. The balance is being expended under contract with Hugo & Tims in building the shore spur, and will pay for about 1,000 linear feet in addition to the extra expense involved by reason of the above change in plans.

Seven thousand three hundred and sixty-three linear feet of the breakwater was completed in 1893; subsequent appropriations were used in strengthening and maintaining the old work and in dredging.

The total amount expended under approved project and in repairs to June 30, 1899, was $237,735.79.

The breakwater has a marked influence in improving the tranquillity of the harbor.

The commerce of this port consists principally of iron ore and lumber exported, and coal, mineral oil, and general merchandise imported. The commerce has largely increased during the fourteen years the harbor has been under improvement by the United States, from 892 arrivals and clearances with cargo tonnage of 1,400,000 tons in 1887, to 2,363 arrivals and clearances with cargo tonnage of 4,000,000 tons in 1899, the total commerce having a valuation, roughly estimated, of $355,000,000.

July 1, 1899, balance unexpended	$36,764.21
June 30, 1900, amount expended during fiscal year	11,016.52
July 1, 1900, balance unexpended	25,747.69
July 1, 1900, amount covered by uncompleted contracts	22,000.00
July 1, 1900, balance available	3,747.69
Amount (estimated) required for completion of existing project	426,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix K K 4.)

5. *Harbor at Ontonagon, Mich.*—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers, was adopted. The west pier was built to a length of 2,675 feet and the east pier to a length of 2,315 feet. This brought the outer end of the west pier very nearly to the 18-foot curve of depth, as proposed. But this curve has advanced since, owing to the very considerable volume of sand carried into the lake by the river, and as it appears probable that the advance of the bar will keep pace with the extension of the piers unless a very considerable extension is made at once, it does not appear that economic considerations would justify any further extension of the piers. It seems that better results will be secured by keeping the piers in repair and by dredging across the bar after each spring freshet.

As far as new work is concerned the project may be said to be completed, and further expenditure will be needed only for keeping a 12-foot channel open by dredging and for the repairs to the piers.

The balance of the $10,000 appropriated by the act of June 3, 1896, is being used in repairs to the outer end of the east pier under contract after due advertisement.

There is still a good 12-foot stage of water between the piers and out into the lake, but as this is liable to be impaired each spring by sediment brought down by the high water of the Ontonagon River, a dredging fund of $8,000 should be always available, if it be intended to maintain the 12-foot depth.

The total cost of the improvement to June 30, 1900, was $337,306.46. This has resulted in keeping open a good navigable 12-foot channel. The great fire in 1896 destroyed the principal commercial industry, the plant of the Diamond Match Company, and this company has not rebuilt. In 1867 there were 449 arrivals and departures with 5,000 tons of cargo for this port. In 1899 there were 394 arrivals and departures with 1,518 tons cargo, with 1,500,000 feet of logs. In addition there were many tugs and vessels seeking refuge not recorded.

July 1, 1899, balance unexpended	$8,613.17
June 30, 1900, amount expended during fiscal year	791,63
July 1, 1900, balance unexpended	7,821.54
July 1, 1900, amount covered by uncompleted contracts	7,000.00
July 1, 1900, balance available	821.54
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix K K 5.)

6. *Waterway across Keweenaw Point from Keweenaw Bay to Lake Superior, Michigan.*—This work was formerly reported on as the Portage Lake and Lake Superior canals, across Keweenaw Point, Michigan.

In accordance with the provisions of the river and harbor act of September 19, 1890, the United States purchased and assumed the charge and care of these canals on August 3, 1891.

At the time of purchase by the United States there was a very poor

13-foot navigation; the channel was narrow and crooked, with many sharp bends; it was poorly marked and lighted; the entrance piers were in a very bad condition; the revetments were rotten or entirely gone, and there was a tax on the commerce through the canals in the shape of a tonnage charge.

The improvements consist of entrance piers at the harbor entrances on Lake Superior and Keweenaw Bay, canals and canal revetments, and dredged cuts and channel ways. There are no locks.

The approved project is for a 20-foot channel 120 feet wide, a renewal of the canal revetments, a reconstruction of the piers at the upper and lower entrances, and their extension to 30 and 20 feet of water, respectively.

The act of June 3, 1896, authorized continuing contracts to complete the above to the amount of $1,065,000.

The sundry civil act of June 4, 1897, appropriated $350,000; that of July 1, 1898, $450,000, and that of June 6, 1900, $110,000, making a total of $910,000, for the execution of these contracts, three of which have been completed, leaving three still operative; one for 5,480 feet of breakwater piers at the upper entrance, to cost $300,000; one for widening the upper canal by dredging, to cost $165,000, and one for revetment work at the upper canal, to cost $135,000. All of the above are now well under way.

The pier extension at the Keweenaw entrance, the revetment work on the canal cuts at the lower entrance, and the dredging along the Portage River have been completed.

During the past season of navigation, that of 1899, the commerce through this waterway amounted to 1,422,784 tons of commodities, having an estimated value of $54,994,844, and 34,714 passengers, being an increase over the traffic of 1898 of 196,761 tons, $15,740,428.50 in value, and an increase of 4,309 passengers, respectively.

During the fiscal year ending June 30, 1900, $107,941.78 has been expended in dredging, $120,000 in pier work, and $60,000 for revetment work, including contingencies, etc.

Amount expended on this work to June 30, 1899, $452,307.11.

July 1, 1899, balance unexpended		$577,692.89
Amount appropriated by sundry civil act approved June 6, 1900		110,000.00
		687,692.89
June 30, 1900, amount expended during fiscal year		287,941.78
July 1, 1900, balance unexpended		399,751.11
July 1, 1900, outstanding liabilities	$27,700.09	
July 1, 1900, amount covered by uncompleted contracts	382,445.93	
		410,146.02

Amount (estimated) required for completion of existing project	155,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	155,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K K 6.)

7. *Operating and care of waterway across Keweenaw Point from Keweenaw Bay to Lake Superior, Michigan.*—The expenses of operating and care of this waterway for the fiscal year ending June 30, 1892, during which it was acquired by the United States, were paid by an appropriation of $10,000 made for the purpose by act of September 19, 1890.

During the fiscal year ending June 30, 1900, $8,300 from the permanent-indefinite appropriation of July 5, 1884, was expended in maintaining by dredging a practicable 20-foot stage of water, in superintendence and general operation of the canals, and in guarding against encroachments on the legally established harbor lines.

(See Appendix K K 6.)

8. *Harbor at Marquette, Mich.*—Originally this harbor afforded no protection to vessels from easterly or northeasterly storms, and projects were approved for the construction of a breakwater composed of cribs filled with rock and projecting from the shore into the bay a distance of 3,000 feet. This breakwater was finished in 1894, practically as projected, but since its commencement extensive repairs have been made to the superstructure. The harbor has natural deep water of 18 feet or more.

A project for a concrete superstructure was approved in February, 1890. Its estimated cost was $232,936.71.

Work on this concrete superstructure was begun in the spring of 1895, and 1,500 linear feet has been completed.

The small balance now on hand will be needed for temporary repairs to the old timber superstructure, about 800 feet of which is in a very rotten condition.

In this latitude the working season is very short, especially for concrete made in place. For this reason it will be decidedly economical to have sufficient funds in hand at one time to utilize the whole of two consecutive seasons.

The breakwater has given complete protection to the harbor, and commerce has grown steadily until it amounts now to some $5,000,000 annually.

During the fiscal year ending June 30, 1872, there were 780 arrivals and clearances of vessels, with a registered tonnage of 370,000 tons. In 1899 there were 2,752 arrivals and clearances, with a registered tonnage of 3,427,903.

The permanent maintenance of the breakwater by a durable concrete superstructure will do away with the frequent and expensive repairs incident to timber work.

The total cost of the work to June 30, 1899, was $536,370.61, of which $66,638.17 was under present project.

July 1, 1899, balance unexpended	$22,187.15
Amount credited June 15, 1900, account of overpayment, July, 1898	.93
	22,188.08
June 30, 1900, amount expended during fiscal year	21,121.51
July 1, 1900, balance unexpended	1,066.57
Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	54,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix K K 7.)

9. *Harbor of refuge, Marquette Bay, Michigan.*—This is a work authorized by the act of June 3, 1896. Marquette Bay is a small bay

within the city limits of Marquette, north of Marquette proper, and distant 1¼ miles therefrom.

A resolution of Congress approved March 20, 1896, directed the Secretary of War to make a survey and submit an estimate for a breakwater in this bay. The results of this survey, with estimates amounting to $20,000 for breakwater 500 feet long and $50,000 for construction of one 1,000 feet long, were published in House Doc. No. 318, Fifty-fourth Congress, first session.

The approved project is to build a breakwater 1,000 feet in length off Presque Ile Point. Of this, nearly 1,000 feet and a crib extension toward shore, 50 feet long, have been completed, 500 linear feet and the crib extension having been built under a previous appropriation.

The act of March 3, 1899, appropriated $30,000 for the completion of the improvement of this harbor. This is being expended in building a 500-foot extension to the present breakwater, and the work is being done under contract at a total cost of $27,000. It is expected the work will be completed by July 15, 1900.

Arrivals and clearances in 1896, 414, with tonnage of 347,781 tons, and in 1899 1,166 arrivals and clearances, with tonnage of 1,475,787 tons, valued at $3,250,000.

Total expended to June 30, 1899, $19,579.51.

July 1, 1899, balance unexpended		$30, 420. 49
June 30, 1900, amount expended during fiscal year		11, 626. 13
July 1, 1900, balance unexpended		18, 794. 36
July 1, 1900, outstanding liabilities	$1, 080. 00	
July 1, 1900, amount covered by uncompleted contracts	16, 200. 00	
		17, 280. 00
July 1, 1900, balance available		1, 514. 36

(See Appendix K K 8.)

10. Harbor of refuge at Grand Marais, Mich.—Originally the entrance to this harbor was obstructed by a bar having but 9 feet depth of water upon it. The project for its improvement, adopted in 1881, has for its object a deep and safe channel into the harbor, making it a harbor of refuge. This object is to be attained by building parallel piers projecting into the lake and dredging out a channel between them, connecting the deep water of the lake with that of the harbor, and by closing up the natural entrance, 5,700 feet in width, by a solid pile dike, driven with a slope toward the waves and strongly braced. The proposed length of each pier was 1,800 feet. The west pier has now reached a length of 1,656 feet, and the east pier 1,153 feet.

An examination made in May, 1899, showed a least depth of 14 feet along the channel between the piers. The pile dike, finished August 5, 1897, has successfully withstood the fall and spring storms and the action of the ice during three years. It is reported to be continually gaining in strength, due to the accumulation of sand against it.

The act of March 3, 1899, appropriated $25,000 for continuing the improvement of this harbor. Of this amount $10,000 was expended last summer in repairs to the piers, and the balance is being expended in extending the east pier by a crib substructure temporarily decked over at the water surface, under contract after due advertisement.

The commerce of this place has increased from 1,910 tons in 1887 to 116,050 tons in 1899. In 1892 310 vessels entered and departed, while in 1899 864 entered and departed. Value of commerce, including logs, $1,735,500.

The total amount expended to June 30, 1899, was $305,495.25. The result has been the creation of a very safe and commodious harbor of refuge for vessels drawing 13 feet. It is expected that the completion of the project will make this safely accessible for vessels of 16 feet draft.

July 1, 1899, balance unexpended	$24, 754. 75
June 30, 1900, amount expended during fiscal year	9, 494. 02
July 1, 1900, balance unexpended	15, 260. 73
July 1, 1900, amount covered by uncompleted contracts	14, 470. 00
July 1, 1900, balance available	790. 73
Amount (estimated) required for completion of existing project	153, 750. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	70, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix K K 9.)

EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and survey of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. Clinton B. Sears, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. J. W. Barlow, Corps of Engineers:

1. *Report upon the feasibility and advisability of constructing a canal between Lake Superior and the Mississippi River.*—Major Sears submitted report June 14, 1899. He considers the construction of such a canal to be feasible and estimates the cost at $6,012,500 and $350,000 per annum for operation and maintenance. In his opinion, concurred in by the division engineer and by me, the improvement is not one which should be undertaken by the General Government. The report was transmitted to Congress and printed in House Doc. No. 69, Fifty-sixth Congress, first session. (See also Appendix K K 10.)

2. *Preliminary examination at Two Islands, or Saxton, Minn.*—Major Sears submitted report July 12, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 138, Fifty-sixth Congress, first session. (See also Appendix K K 11.)

3. *Preliminary examination and survey of harbor at Portwing, Wis.*—Major Sears submitted reports dated June 13 and November 20, 1899, respectively. A plan for improvement, at an estimated cost of $44,992, is presented, and in the opinion of Major Sears, concurred in by the division engineer, the locality is worthy of improvement by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 114, Fifty-sixth Congress, first session. (See also Appendix K K 12.)

4. Preliminary examination and plan and estimate for improvement of Copper Harbor, Michigan.—Major Sears submitted reports dated August 17 and October 14, 1899, respectively, with plan for improvement at an estimated cost of $2,000. The reports were transmitted to Congress and printed in House Doc. No. 86, Fifty-sixth Congress, first session. (See also Appendix K K 13.)

EXAMINATION OF BURLINGTON BAY, MINNESOTA, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Burlington Bay, Lake County, Minn., with a view to improving said bay and the construction of a harbor therein*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS ON WESTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Capt. J. G. Warren, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Menominee Harbor, Michigan and Wisconsin.—The survey made in 1871 with a view to the improvement of the entrance to the Menominee River showed that it had a depth of 5 feet. The project for its improvement, adopted in 1871 and modified in 1874, provided for construction of two parallel piers 400 feet apart and for dredging between them, the object being to secure a channel of navigable width not less than 15 feet deep. In 1890 this was modified to secure a depth of 17 feet.

The amount expended up to June 30, 1899, was $229,007.11.

The original and modified projects have been completed, and the full depth of 17 feet below the datum plane has been secured.

Dredging during the fiscal year, under appropriation for Menominee River, has secured a channel 20 feet deep between the piers. (See Menominee River report.)

Repairs have been made to the south pier.

The maximum draft that could be carried June 30, 1900, was 18.7 feet.

Commercial statistics for 1899.—Arrivals of vessels, 839; tonnage, 324,046. Total approximate value of imports by way of harbor, $2,400,000; exports, $1,600,000.

July 1, 1899, balance unexpended	$5,704.89
June 30, 1900, amount expended during fiscal year	2,549.16
July 1, 1900, balance unexpended	3,155.73
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L L 1.)

2. Menominee River, Michigan and Wisconsin.—The survey made in 1889, with a view to the improvement of the Menominee River, showed a governing depth of about 5 feet, and that by private enterprise a tortuous channel had been dredged about 50 feet wide and 14 feet deep, extending up the river a distance of 2 miles.

The original project of 1890 provided for the expenditure of $54,000 for dredging a channel 200 feet wide and 17 feet deep from Green Bay up the Menominee River as far as available funds would admit.

In 1892 additional funds were appropriated, and the project provided for making the 200-foot channel about 9,000 feet long, and thence for a distance of 2,600 feet reducing its width to 100 feet. The act of June 3, 1896, appropriated $15,000 and provided for the formation of a turning basin 600 feet long and 250 feet wide; also for extending the channel 425 feet, with a width of 75 feet.

The river and harbor act of March 3, 1899, appropriated $18,920 for improving Menominee River, "according to the second, or dredging, plan reported November 30, 1896." This plan (printed in the Annual Report of the Chief of Engineers for 1897, p. 2751 et seq.) was for a 20-foot channel in Menominee Harbor. The substitution of the word "river" for "harbor" was evidently a mistake; but to carry out the evident intention of the act, the money appropriated is now being expended in furtherance of the dredging plan alluded to, under improvement of Menominee River.

The sum of $18,920 appropriated by river and harbor act of March 3, 1899, was expended in securing a channel 20 feet deep and 300 feet wide between the harbor piers, as explained in reports on Menominee River for 1899. (See Annual Report of the Chief of Engineers for 1899, pp. 457 and 2728.)

The total amount expended to June 30, 1899, was $95,599.55.

The original and modified projects have been completed.

Soundings taken in January, 1900, showed considerable shoaling in channel and basin.

The maximum draft that could be carried June 30, 1900, was 15.7 feet.

A survey of the river was made in compliance with the terms of the river and harbor act of March 3, 1899, and the report printed in House Doc. No. 419, Fifty-sixth Congress, first session; it is also submitted as Appendix L L 22 of this report.

The commercial statistics for Menominee River are the same as for Menominee Harbor. (See Menominee Harbor report.)

July 1, 1899, balance unexpended	$18,900.48
June 30, 1900, amount expended during fiscal year	18,092.27
July 1, 1900, balance unexpended	808.21
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	7,500.00

(See Appendix L L 2.)

3. *Oconto Harbor, Wisconsin.*—In its natural condition the channel at the entrance to the Oconto River was obstructed by a bar with less than 3 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens, by the construction of a small amount of slab pier and by dredging, had increased the depth to 4½ feet.

The part of the river between the mouth and the city of Oconto had a width of from 150 to 250 feet and a low-water channel depth of from 4 to 6 feet.

The project of improvement adopted in 1882 proposed to secure a 9-foot channel from Green Bay to the city of Oconto, a distance of 2 miles, by dredging and constructing piers, at an estimated cost of $150,000.

A modification adopted in 1897 provided for making Spies's mill the terminus of the improved channel, thereby abandoning 3,800 linear feet of the originally projected improvement.

The total amount expended up to June 30, 1899, was $78,265.17.

At that date the south pier was of its projected length, and to complete the north pier to its full length an extension of 875 feet was required. The channel had a depth of 8 feet.

Soundings taken in May, 1900, showed a channel 9 feet deep below datum with a least width of 70 feet.

Dredging for restoration of channel was completed in August, 1899. Extensive repairs were made to the piers.

The actual depth June 30, 1900, was 7.7 feet.

A preliminary examination of the harbor was made in compliance with the terms of the river and harbor act of March 3, 1899, and report thereon printed in House Doc. No. 50, Fifty-sixth Congress, first session; it is also submitted as Appendix L L 23 of this report.

Commercial statistics for 1897.—Arrivals of vessels, 630; tonnage, 36,550. Exports, lumber and saw logs, 35,250 tons; imports, stone, 49,000 tons.

July 1, 1899, balance unexpended	$14,734.83
June 30, 1900, amount expended during fiscal year	13,362.14
July 1, 1900, balance unexpended	1,372.69
Amount (estimated) required for completion of existing project	22,610.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 3.)

4. Green Bay Harbor, Wisconsin.—The original channel from Green Bay into the Fox River was circuitous and narrow, with but 11 feet of water at its shoalest point. The original project for its improvement was adopted in 1866 and modified in 1872, 1874, and 1892, to secure greater depth, and provides for a dredged channel 16,500 feet long, 200 feet wide, and 17 feet deep, passing through a revetted cut in Grassy Island. The project adopted in 1897 provided for increasing the width of entrance at north end of channel to 500 feet.

The Fox River below Depere, Wis., was included in the Green Bay appropriations of July 13, 1892, and June 3, 1896, and the project adopted in 1896 provides for the same depth as in the other channel.

The total amount expended up to June 30, 1899, was $375,628.77.

At that date the channel from Green Bay into the Fox River had a depth of 17 feet, with a least width of 200 feet.

The channel in the Fox River below Depere had a depth of 14 feet for a width of 100 feet.

A channel 17 feet deep and 150 feet wide was dredged in the Fox River below Depere, Wis. Minor repairs were made to revetments at Grassy Island.

Soundings taken in the winter of 1900 showed a channel 17 feet deep below datum from deep water in Green Bay to Depere, Wis.

The maximum draft that could be carried June 30, 1900, from Green Bay into the Fox River was 16 feet.

A survey was made in compliance with the terms of the river and harbor act of March 3, 1899, and report thereon printed in House Doc. No. 232, Fifty-sixth Congress, first session. It is also submitted as Appendix L L 24 of this report.

Commercial statistics for 1899.—Arrivals of vessels, 624; tonnage, 304,392; exports, 164,759 tons; imports, 256,625 tons.

July 1, 1899, balance unexpended	$30,573.73
June 30, 1900, amount expended during fiscal year	23,140.75
July 1, 1900, balance unexpended	7,432.98
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L L 4.)

5. *Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—In its natural condition Lake Michigan was separated from Sturgeon Bay, an arm of Green Bay, by a neck of land about 1⅜ miles wide, having a maximum elevation above the lake level of about 28 feet. The Sturgeon Bay and Lake Michigan Ship Canal and Harbor Company, from 1872 to 1881, constructed across this neck a canal without locks or gates, 7,200 feet long, 100 feet wide at water surface, and 14 feet deep, and in continuation of the canal dredged a channel in Sturgeon Bay 6,100 feet long, of about the same dimensions as the canal. Of the 14,400 linear feet of canal banks, 8,437 feet was provided with pile revetments. The United States assumed possession of the canal April 25, 1893. The project of 1894 provided for an extension of the revetments with an offset of 30 feet on each side, for fender piling, and for dredging to obtain a depth of 15 feet. The modification adopted in 1896 provided for a width of 250 feet between revetments for the westerly 1,000 feet of the canal and for a channel 200 feet wide in the bay; also for widening the entire canal to 160 feet when the old revetment required rebuilding.

The total amount expended to June 30, 1899, was $135,534.34, of which amount $81,833 was for the purchase of the canal by the United States.

The expenditures during the fiscal year ending June 30, 1900, were chiefly for building 687 linear feet of south revetment and dredging 122,104 cubic yards of material. About 350 feet of westerly end of canal remains to be revetted on both sides.

The canal affords a considerable shortening of distance for many vessels over the natural outlet of Green Bay into Lake Michigan, avoids the dangers of the natural route, and makes Sturgeon Bay available and accessible as a harbor of refuge for vessels on Lake Michigan with a draft of less than 15 feet.

The maximum draft that could be carried June 30, 1900, was 15 feet.

Commercial statistics for 1899.—Number of vessels passing through the canal, 3,840; tonnage, 1,417,112. Bound up, lumber, 553,840 tons; bound down, coal, 14,903 tons.

July 1, 1899, balance unexpended	$26,298.66
June 30, 1900, amount expended during fiscal year	18,082.03
July 1, 1900, balance unexpended	8,216.63
July 1, 1900, outstanding liabilities	20.86
July 1, 1900, balance available	8,195.77
Amount (estimated) required for completion of existing project	33,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 5.)

6. *Operating and care of Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—Under an allotment from the indefinite appropriation of July 5, 1884, for operating and care of canals and other works of navigation, there has been expended during the fiscal year ending June 30, 1900, $135,220.43. The principal work has been the renewal and repairs to canal revetments and dredging. The riprap protection along the harbor front was repaired with additional stone; the grounds adjacent to the canal buildings were graded and the buildings repaired and painted; the pile driver repaired, and 19,540 cubic yards of material dredged from the canal; also, two dump scows, each of 140 cubic yards capacity, were built.

Navigation through the canal opened April 19, 1899; was maintained until practically closed by ice December 22, 1899, and reopened April 20, 1900.

During the greater portion of the winter the car ferry steamers of the Ann Arbor Railroad Company endeavored to maintain navigation between Frankfort and Menominee, Mich., via the canal. No serious groundings occurred in the canal on account of an insufficient depth of water.

The water reached its lowest stage for the year on December 28, 1899, when it was 6.01 feet below high-water mark of 1838, and its highest stage June 10, 1900, when it was 2.2 feet below that point.

For commercial statistics see report on Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.

(See Appendix L L 6.)

7. *Sturgeon Bay Canal harbor of refuge, Wisconsin.*—Before the construction of this harbor was undertaken, the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms from northeast to southwest.

The project of constructing a harbor of refuge at this point was adopted in 1873 and modified in 1879 and 1880. The modified project, as carried out and completed in 1884, consisted of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres, with a depth of at least 17 feet.

The total expenditure at this harbor up to June 30, 1899, was $185,105.44. This expenditure resulted in the completion of the piers as projected, and in a dredged channel 17 feet deep and 150 feet wide from the 17-foot contour in Lake Michigan to the canal entrance.

The expenditures during the fiscal year ending June 30, 1900, have been for repairs to the piers, redredging, repairs to the dredging plant, and renewal of the guide piling that connects the main and detached piers.

Soundings taken in February, 1899, showed a depth of about 16 feet below datum. In April, 1900, there was a depth of 16.8 feet.

The maximum draft that could be carried, June 30, 1900, was 15.5 feet.

The commercial statistics for this harbor will be found in report on Sturgeon Bay and Lake Michigan Ship Canal.

July 1, 1899, balance unexpended	$3,577.06
June 30, 1900, amount expended during fiscal year	2,924.51
July 1, 1900, balance unexpended	652.55
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 7.)

8. *Ahnapee Harbor, Wisconsin.*—Previous to the improvement of this harbor, the depth of water at the mouth of the Ahnapee River was only 3 feet.

The project for improvement adopted in 1875, and modified in 1884, provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 13 feet deep, formed by the construction of two piers extending to the 19-foot contour, with a 200-foot entrance channel between the pierheads.

By a modification of project adopted in 1897 further extension of the piers was abandoned.

The project adopted by the river and harbor act of March 3, 1899, provides for the formation of a channel 13 feet deep and 50 feet wide, extending up the river from the head of present channel for 800 feet, by rock removal and dredging.

The total amount expended up to June 30, 1899, was $185,037.83.

Both piers have been built to their projected length.

Soundings taken in April, 1899, showed a depth varying from 16 feet at entrance to 14 feet at shore end of piers.

June, 1900, their depths varied from 16½ feet to 13½ feet below datum. The channel provided for by project of 1899 is only partially completed. It has a depth of 10 feet and a least width of 30 feet for a length of 520 feet.

The maximum draft that could be carried, June 30, 1900, was about 12 feet.

Drilling, blasting, and dredging for rock removal have been in progress during the fiscal year.

Commercial statistics for 1899.—Arrivals of vessels, 770; tonnage, 277,800. Exports and imports were 31,875 and 26,095 tons, respectively, by all ways of transportation, their approximate values being $1,237,325 and $938,000.

July 1, 1899, balance unexpended	$11,182.17
June 30, 1900, amount expended during fiscal year	9,560.92
July 1, 1900, balance unexpended	1,621.25

Amount (estimated) required for completion of existing project	19,266.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 8.)

9. Kewaunee Harbor, Wisconsin.—The original entrance to the Kewaunee River was not more than 20 feet wide, with a depth of about 3 feet at its shoalest point, and was obstructed by submerged bowlders.

The project for its improvement, adopted in 1881, provided for an artificial entrance channel 15 feet deep, located about 2,000 feet south of the river mouth, protected by two parallel piers 200 feet apart, extending from the shore to the 19-foot contour in the lake.

The total amount expended on this harbor up to the close of the fiscal year ending June 30, 1899, was $152,150.39, in addition to which the local harbor commissioners had expended $8,042.72. At that time both piers were of their full projected length. Soundings taken in May, 1899, show a depth of 15 feet, with a least width of 160 feet.

In May, 1900, the depth of channel was 15 feet below datum, with a minimum width of 140 feet.

The actual depth June 30, 1900, was about 13.7 feet.

In compliance with the terms of the river and harbor act of March 3, 1899, a survey was made, and report thereon printed in House Doc. No. 362, Fifty-sixth Congress, first session; it is also submitted as Appendix L L 25 of this report.

Three hundred and twenty-five linear feet of superstructure was rebuilt, the dredging plant repaired, a blacksmith shop built, and dredging done with United States dredges Nos. 1 and 2.

Two dump scows were also built at the Government yard for operating and care of Sturgeon Bay and Lake Michigan Ship Canal.

Commercial statistics for 1899.—Arrivals of vessels, 1,131; tonnage, 467,238. By the way of the harbor only: Total approximate value of exports, $6,985,300; of imports, $4,325,350.

July 1, 1899, balance unexpended	$6,663.61
June 30, 1900, amount expended during fiscal year	6,102.21
July 1, 1900, balance unexpended	561.40

Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 9.)

10. Two Rivers Harbor, Wisconsin.—The original depth of the entrance to Twin Rivers was from 3 to 4 feet. The project adopted in 1870 provided for a 13-foot channel between parallel piers 270 feet apart, extending from the shore line to the 19-foot contour in Lake

Michigan. In 1875 the distance between the piers was reduced 40 feet. In 1897 the project was modified by abandoning any further extension of the piers.

The amount expended thereon up to the close of the fiscal year ending June 30, 1899, was $214,950.21.

A total quantity of 29,774 cubic yards has been dredged for restoration of channel during the fiscal year.

In April, 1899, the governing depth was 12.3 feet below the datum plane. Soundings taken June 15, 1900, on completion of dredging, showed a channel 13 feet deep below the datum plane and 200 feet wide.

The maximum draft that could be carried June 30, 1900, was 11.7 feet.

The superstructure of the pile piers is in a dilapidated condition, and the sheet piling does not prevent the passage of sand through the piers into the channel.

Commercial statistics for 1899.—Arrivals of vessels, 1,560; tonnage, 436,384; exports, 50,833 tons; imports, 61,887 tons.

July 1, 1899, balance unexpended	$7,549.79
June 30, 1900, amount expended during fiscal year	6,226.27
July 1, 1900, balance unexpended	1,323.52
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	16,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 10.)

11. Manitowoc Harbor, Wisconsin.—The original depth of water at the mouth of the Manitowoc River was about 4 feet at the shoalest point. The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers 220 feet apart, and was completed in 1871. In 1881 a modification was adopted to secure 19 feet at the entrance and 15 feet at the shore line by pier extension and dredging, and was completed in 1889. In 1890 a project was adopted for an exterior breakwater 400 feet long to afford protection to vessels entering the harbor during northeast storms. In 1896 a project was adopted for a channel 20 feet deep by extending the south pier and by dredging.

The amount expended thereon up to the close of the fiscal year ending June 30, 1899, was $395,352.03.

At that date the exterior breakwater and the project of 1896 were completed. In April, 1899, the channel was 20 feet deep and 120 feet wide. In April, 1900, it was 100 feet wide.

The maximum draft that could be carried June 30, 1900, was 18.7 feet.

A survey was made in compliance with the terms of the river and harbor act of March 3, 1899, and report thereon printed in House Doc. No. 233, Fifty-sixth Congress, first session; it is also submitted as Appendix L L 27 of this report.

Commercial statistics for 1899.—Arrivals of vessels, 2,026; tonnage, 1,706,685; total approximate value of imports by way of the harbor, $2,700,000; exports, $2,600,000.

July 1, 1899, balance unexpended		$8,428.47
June 30, 1900, amount expended during fiscal year		4,498.63
July 1, 1900, balance unexpended		3,929.84
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900		8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix L L 11.)

12. Sheboygan Harbor, Wisconsin.—The entrance to this harbor had originally a depth not exceeding 7 feet. The original project, adopted in 1866, had for its object a 13-foot channel between approximately parallel piers. This project was modified in 1873 to secure a deeper channel, and in 1881 by extending the piers to the 21-foot contour in the lake and dredging to a depth of 19 feet at the outer ends, gradually diminishing to 15 feet at their shore ends. In 1894 the project was modified to provide for a uniform width between the piers by reconstructing about 1,200 linear feet of the inner end of the south pier and removing the old pier, by dredging, etc.

The project adopted by river and harbor act of March 3, 1899, provides for a breakwater 700 feet long; estimated cost, $77,000.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $393,734.

At that date there remained about 100 feet of each pier and 700 feet of breakwater to be built; there was a channel 19 feet deep, with a least width of 150 feet.

Soundings taken in April, 1900, showed a channel 19 feet deep, with a least width of 155 feet.

The maximum draft that could be carried June 30, 1900, was 17.7 feet.

During the fiscal year the outer bar was removed and shoals removed from the channel. A contract was entered into for the construction of 600 linear feet of the breakwater on a foundation of stone; the foundation was nearly completed and crib construction begun. This contract is to be completed December 31, 1900.

Commercial statistics for 1899.—Arrivals of vessels, 1,248; tonnage, 746,914; exports, 466,328 tons; imports, 575,671 tons.

July 1, 1899, balance unexpended		$29,114.91
Amount appropriated by sundry civil act approved June 6, 1900		52,000.00
		81,114.91
June 30, 1900, amount expended during fiscal year		2,699.87
July 1, 1900, balance unexpended		78,415.04
July 1, 1900, outstanding liabilities	$7,016.06	
July 1, 1900, amount covered by uncompleted contracts	64,350.94	
		71,367.00
July 1, 1900, balance available		7,048.04
Amount (estimated) required for completion of existing project		14,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		48,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix L L 12.)

13. Port Washington Harbor, Wisconsin.—The natural channel at the mouth of the Sauk River was narrow, and at the shoalest point had a depth of 1 foot.

The original project for the improvement of this harbor was adopted in 1869, and provided for two parallel piers extending to 11 feet of water in Lake Michigan and the excavation of an interior basin. This plan was modified in 1870 and again in 1876, and now provides for the excavation of two interior basins with a combined area of 5¾ acres and a depth of 13 feet and a channel of the same depth connecting the basins with the lake between piers extending to the 15-foot contour.

The amount expended thereon up to the close of the fiscal year ending June 30, 1899, was $195,525.98.

The piers were completed in 1893, and the channel and basins had been excavated to their required depth. May, 1899, the governing depth was 13 feet below datum for a width of 50 feet.

Soundings taken in April, 1900, showed a channel 13 feet deep below datum, with a least width of 60 feet, and a bar at entrance with a minimum depth of about 12½ feet.

Dredging for restoration of channel is in progress.

The maximum draft that could be carried June 30, 1900, was 11.7 feet.

Commercial statistics for 1899.—Arrivals of vessels, 125; tonnage, not given; value of exports and imports by way of the harbor, $811,360.

July 1, 1899, balance unexpended	$3,410.52
June 30, 1900, amount expended during fiscal year	1,536.12
July 1, 1900, balance unexpended	1,874.40
July 1, 1900, outstanding liabilities	15.35
July 1, 1900, balance available	1,859.05
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 13.)

14. Harbor of refuge, Milwaukee, Wis.—Milwaukee Bay, in which the harbor of refuge is located, is protected by the coast from storms excepting those from the northeast to the southeast, and, while the anchorage ground was good, vessels were in danger of dragging their anchors or of failing to effect an anchorage at the proper place.

A Board of Engineers, in its report dated April 21, 1881, recommended a plan for a breakwater to inclose a portion of the bay 417 acres in extent, beyond the 19-foot contour, and about twice that area beyond the 13-foot contour. Work began in 1881, and up to June 30, 1899, there had been expended $797,155.68, resulting in the completion of 6,350 feet of substructure and 4,450 feet of superstructure, and extensive repairs. Since then the substructure has been extended 600 feet, making a total of 6,950 feet. Repairs have been made to the breakwater.

The contract now in force provides for the completion of the present project December 31, 1900.

A temporary light has been established by the Light-House Establishment, to be replaced by a permanent light on completion of the breakwater.

The superstructure of the north or shore arm of the breakwater requires rebuilding, and it is proposed to renew the same with concrete.

The commercial statistics are the same as for Milwaukee Harbor.

It is estimated that $119,000 will be required for rebuilding superstructure with concrete, and for maintenance and repairs to breakwater, for fiscal year ending June 30, 1902.

July 1, 1899, balance unexpended		$52,844.32
Amount appropriated by sundry civil act approved June 6, 1900		105,650.00
		158,494.32
June 30, 1900, amount expended during fiscal year		39,652.88
July 1, 1900, balance unexpended		118,841.44
July 1, 1900, outstanding liabilities	$11,907.72	
July 1, 1900, amount covered by uncompleted contracts	97,738.87	
		109,646.59
July 1, 1900, balance available		9,194.85
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		119,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix L L 14.)

15. Milwaukee Harbor, Wisconsin.—The original depth of water at the mouth of Milwaukee River was not more than 4½ feet. The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers located about 3,000 feet north of the natural mouth of the river. In 1868 this project was modified to secure a channel 19 feet deep by extension of piers and dredging.

The project adopted by river and harbor act of March 3, 1899, provides for increasing the depth to 21 feet, width of channel between piers to be 225 feet, and width outside pierheads to be 600 feet.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $361,773.79. The harbor piers were completed to their projected length in 1872; the channel was deepened to 21 feet below datum in 1899.

In April, 1899, there was a channel 19 feet deep with a least width of 90 feet. Soundings taken in April, 1900, showed a channel 21 feet deep below datum with a least width of 180 feet.

The maximum draft that could be carried June 30, 1900, was 19.7 feet.

Repairs to the piers have been made. Repairs of stone superstructure of the north pier are greatly needed. The present superstructure should be rebuilt with concrete.

Commercial statistics for 1899.—Arrivals of vessels, 5,751; tonnage, 4,815,676.

Of the harbors on Lake Michigan this is the second in importance.

It is estimated that $51,000 will be required for renewal of stone superstructure and maintenance during the fiscal year ending June 30, 1902.

July 1, 1899, balance unexpended	$17,651.57
June 30, 1900, amount expended during fiscal year	9,085.05
July 1, 1900, balance unexpended	8,566.52
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	51,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix L L 15.)

16. South Milwaukee Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure to about 3 feet. The project of improvement adopted in 1896 provides for a channel 18 feet deep, 200 feet wide between parallel piers, at an estimated cost of $138,000.

The amount expended thereon up to the close of the fiscal year ending June 30, 1899, was $4,721,19.

At that date the north pier had been extended 185 feet. In April, 1897, there was a channel depth varying from 9 feet to nearly absolute closure.

The improvement of this harbor is not yet far enough advanced to make it of any value for purposes of navigation and commerce.

Commercial statistics.—There are no available statistics of arrivals and departures of vessels. Exports and imports by all ways of transportation: Exports, 67,438 tons; value, $3,870,500. Imports, 196,753 tons; value, $3,394,437.25.

July 1, 1899, balance unexpended	$278.81
June 30, 1900, amount expended during fiscal year	1.65
July 1, 1900, balance unexpended	277.16
Amount (estimated) required for completion of existing project	133,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 16.)

17. Racine Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure after storms to about 7 feet. The original project in 1842 or 1843 provided for a channel 13 feet deep between parallel piers. In 1866 the project was modified to provide a channel 16 feet deep, and further modified in 1889 for 17 feet, by pier extension and dredging.

The project adopted by the river and harbor act of March 3, 1899, provides for widening channel and increasing depth therein to 21 feet, by pier extension and dredging; also for a breakwater 600 feet long. Total estimated cost, $117,650.

The amount expended up to the close of fiscal year ending June 30, 1899, was $338,418.19.

Soundings taken in April, 1899, showed a channel 15 feet deep; least width, 35 feet.

April, 1900, there was a channel 16½ feet deep below datum, with a least width of 40 feet.

The maximum draft that could be carried June 30, 1900, was 15.2 feet.

Repairs to piers have been made. Work under contracts is in progress. Contracts now in force provide for completion of present project December 31, 1900.

Commercial statistics for 1899.—Arrivals of vessels, 1,733; tonnage, 1,091,851. By all ways of transportation: Exports, 220,583 tons; imports, 216,894 tons.

July 1, 1899, balance unexpended		$48,366.81
Amount appropriated by sundry civil act approved June 6, 1900		67,650.00
		116,016.81
June 30, 1900, amount expended during fiscal year		28,241.99
July 1, 1900, balance unexpended		87,774.82
July 1, 1900, outstanding liabilities	$9,882.00	
July 1, 1900, amount covered by uncompleted contracts	71,238.65	
		81,120.65
July 1, 1900, balance available		6,654.17
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		17,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L L 17.)

18. Kenosha Harbor, Wisconsin.—The original depth of water at the mouth of Pike Creek varied from nothing to 4 feet. The original plan of improvement was adopted in 1852 and had for its object a channel 13 feet deep, to be secured by constructing parallel piers and dredging between them. In 1889 the project was modified to secure 16 feet by pier extension and dredging. The river and harbor acts of September 19, 1890, and June 3, 1896, required dredging in the basin just inside the harbor piers. The project adopted by river and harbor act of March 3, 1899, provided for increasing depth in channel and basin to 21 feet and 20 feet, respectively, and for widening channel by pier extension and dredging; also a breakwater 600 feet long. Total estimated cost, $191,000.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $298,012. Soundings taken in April, 1899, showed a channel 16 feet deep, least width 60 feet, and a depth of 15 feet over about 3½ acres in basin.

April, 1900, there was a channel 70 feet wide and 16.5 feet deep below datum. The maximum draft that could be carried June 30, 1900, was 15.2 feet.

Repairs to the piers have been made. Work under contracts continued, resulting in completing the foundation for the breakwater, building 925 linear feet of north pier on the rectified line, removing about two-thirds of the old north pier, and obtaining the required depth of 20 feet over about two-thirds of the area of the basin.

Contracts now in force provide for completion of present project December 31, 1900.

Commercial statistics for 1899.—Arrival of vessels, 293; tonnage, 63,215. The approximate exports and imports by all ways of transportation, as reported by Mr. H. S. Van Ingen, were: Exports, 110,705 tons; value, $18,000,000. Imports, 350,723 tons; value, $11,500,000.

July 1, 1899, balance unexpended		$51,295.41
Amount appropriated by sundry civil act approved June 6, 1900		135,000.00
		186,295.41
June 30, 1900, amount expended during fiscal year		32,980.38
July 1, 1900, balance unexpended		153,315.03
July 1, 1900, outstanding liabilities	$3,175.44	
July 1, 1900, amount covered by uncompleted contracts	122,346.38	
		125,521.82
July 1, 1900, balance available		27,793.21
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		9.900.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L L 18.)

19. *Waukegan Harbor, Illinois.*—There was no navigable channel or natural harbor at this place. The project of improvement, adopted in 1880, had for its object the construction of an artificial harbor of sufficient capacity for local trade by inclosing a portion of Lake Michigan with pile piers, the entrance channel and inclosed area to be dredged to 13 feet. In 1882 this project was modified by reducing the area of the exterior basin and by obtaining the additional space needed by dredging an interior basin connected by a narrow channel with the exterior basin. It has become necessary to abandon the interior basin because the land required was not secured for the purpose, and it is now practically impossible to secure possession. The present project provides for a basin 300 feet wide and 967 feet long.

The amount expended thereon up to the close of the fiscal year ending June 30, 1899, was $214,893.24.

Both piers have been completed to their projected length. In April, 1899, there was a depth in the channel of 13 feet below datum, with a least width of 170 feet.

Private parties have dredged a channel 18 feet deep and about 75 feet wide.

The maximum draft that could be carried June 30, 1900, was 17 feet.

A survey was made in compliance with the terms of the river and harbor act of March 3, 1899, and report thereon printed in House Doc. No. 343, Fifty-sixth Congress, first session; it is also submitted as Appendix L L 30 of this report.

Commercial statistics for 1899.—Arrivals of vessels, 187; tonnage not given. Exports, 150 tons; imports, 56,285 tons, by way of harbor only.

July 1, 1899, balance unexpended	$5,606.76
June 30, 1900, amount expended during fiscal year	841.38
July 1, 1900, balance unexpended	4,765.38
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix L L 19.)

20. *Fox River, Wisconsin.*—The Fox and Wisconsin rivers, separated at Portage City, Wis., by a distance of only 2 miles, one flowing into Lake Michigan, the other into the Mississippi River, were the early means of communication between those waters. In 1846 Congress granted to the State of Wisconsin a quantity of land for the purpose of improving the navigation of this route. By means of a board of public works the State began and carried on the improvement until 1853, when it was transferred to a private company. In 1872 the United States acquired possession of the property, with the exception of the water power, water-power lots, and personal property. The earliest project, that of 1848, called for canals 40 feet wide at bottom and 4 feet deep, with locks 125 feet long and 30 feet wide. This project was enlarged subsequently. The present project is that of a Board of Engineers, submitted September 17, 1884, and modified May 14, 1886. It provides for deepening and widening the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, and from Portage to Montello to 4 feet depth, and for the renovation of 12 old locks.

The amount expended on the Fox and Wisconsin rivers from 1867 to the close of the fiscal year ending June 30, 1899, including $145,000 paid to the Green Bay and Mississippi Canal Company for its property, was $3,068,471.90, of which amount $403,471.90 was appropriated solely for and expended solely upon the Fox River since 1885.

The result of this expenditure upon the Fox River was the construction of 15 new stone locks, 11 composite locks, 16 permanent dams, 12 canals, a head wall and feeder at the old first lock at Appleton, a lock house at Appleton, warehouses at Appleton first lock and Berlin Lock, a wing dam and brush and stone shore protection to the Portage levee, masonry wasteweirs at Little Chute combined locks and Appleton third lock, masonry culvert at head of Little Chute combined locks, a dry dock at Kaukauna, guard gates at head of Kaukauna Canal; also rebuilding canal banks at Kaukauna, wing walls at Kaukauna fourth lock, and 1,237 linear feet of cement-laid rubble-core wall in canal banks of fourth and fifth levels. A channel 75 feet wide and 450 feet long has been secured by blasting and drilling the rock bar below Depere Lock from 4 to 12 inches below the top of the lower miter sill. Channel below Depere has been deepened and channels deepened at mouth of Fond du Lac River, Neenah Channel, Fox River at head of Lake Butte des Morts, Grignon Rapids, below Little Chute and Rapide Croche locks, and in the canals and Upper Fox River. Masonry outlet to wasteweir at Kaukauna second lock, a roadway upon United States property at Appleton first lock, and fishways in the Eureka, Berlin, White River, Princeton, Grand River, Montello, and Fort Winnebago dams have been constructed. A harbor of refuge has been constructed at Stockbridge Landing, Lake Winnebago, and snags have been removed and bars dredged in Wolf River, making a 4½-foot channel 100 feet wide to New London.

The improvement of the Wisconsin River was abandoned in 1887.

The full depth of 6 feet has now been obtained from Depere to White River Lock (milepost 43), with the exception of about 2½ miles between milepost 34 and milepost 37, which is now being dredged, a distance of 99 miles from mouth of Fox River. Above this point the projected depth has not yet been obtained.

The expenditures during the fiscal year ending June 30, 1900, were for dredging Upper Fox and slight dredging on Lower Fox; building harbor revetment in harbor of refuge, east shore of Lake Winnebago; completing removal of snags and dredging bars to New London; replacing steam tug *Boscobel* and survey of Government property along Fox River.

The relative value of the commerce involved and the cost of the improvement can not be estimated.

Its principal effect, so far, has been to cause considerable reduction in freight rates to points in the Fox River Valley. Deepening the channel of the Upper Fox by dredging has also had, and will continue to have, the effect of draining the enormous expanse of meadow lands in the Fox River Valley and greatly increasing their availability and value.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the improvement, was from Depere to White River Lock, 6 feet; from that point to Montello 4 feet; and from Montello to Portage, 3 feet.

The river and harbor act of June 3, 1896, directed that a thorough investigation of the character, limitations, and description of the property and rights of the United States in connection with the improvement of the Fox and Wisconsin rivers be made under the direction of the Secretary of War. The investigation was made by Hon. Edwd. S. Bragg, and report on the subject was submitted by him February 15, 1898. The report was transmitted to Congress and printed in House Doc. No. 389, Fifty-fifth Congress, second session, and also printed in my annual report of 1898, Appendix I I 21.

July 1, 1899, balance unexpended	$31,278.10
June 30, 1900, amount expended during fiscal year	22,006.59
July 1, 1900, balance unexpended	9,271.51
July 1, 1900, outstanding liabilities	232.50
July 1, 1900, balance available	9,039.01
Amount (estimated) required for completion of existing project	153,366.48
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 20.)

21. Operating and care of locks and dams on Fox River, Wisconsin.—Under an allotment from the indefinite appropriation for operating and care of canals and other works of navigation there has been expended during the year ending June 30, 1900, the sum of $73,064.65.

The principal work has been dredging bars and channels; making repairs of locks, dams, canal banks, lock houses, dredges, and boats; rebuilding Appleton third lock, wasteweir, and wall; building dry dock at Kaukauna; building new hull and cabin for steam tug *Fox*, and survey of United States property along Fox River.

A detailed statement, appended to the report of the local engineer officer in charge, shows the items of expenditures.

Navigation was closed November 30, 1899, and reopened April 23, 1900. The water in Lake Winnebago and the Lower Fox has been maintained at the crests of the dams throughout the year, with the exception of Lake Winnebago during the close of navigation, drawn down by the mills with permission of the Secretary of War. Eight-inch flushboards were placed on the Menasha dam by the Neenah and Menasha Water Power Company on July 18, 1899, under conditions of revocable license issued by the Secretary of War.

For commercial statistics see report on Fox River, Wisconsin.

(See Appendix L L 21.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. J. G. Warren, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. J. W. Barlow, Corps of Engineers:

1. *Preliminary examination and survey of Menominee River, Michigan and Wisconsin.*—Captain Warren submitted reports dated April 18, 1899, and January 30, 1900, respectively, with plan for improvement estimated to cost $60,000, and $7,500 annually for maintenance. In the opinion of the local officer the commercial importance of the locality warrants the proposed improvement and his views are concurred in by the division engineer. The reports were transmitted to Congress and printed in House Doc. No. 419, Fifty-sixth Congress, first session. (See also Appendix L L 22.)

2. *Preliminary examination of Harbor at Oconto, Wis.*—Captain Warren submitted report April 18, 1899. In his opinion the harbor is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 50, Fifty-sixth Congress, first session. (See also Appendix L L 23.)

3. *Preliminary examination and survey of Green Bay Harbor, Wisconsin.*—Captain Warren submitted reports dated April 18 and December 12, 1899, respectively, with plan for improvement at an estimated cost of $105,600. The reports were transmitted to Congress and printed in House Doc. No. 232, Fifty-sixth Congress, first session. (See also Appendix L L 24.)

4. *Preliminary examination and survey of harbor at Kewaunee, Wis.*—Captain Warren submitted reports dated April 18, 1899, and January 20, 1900, respectively, with plan and estimate for improvement at a cost of $230,000; but in the opinion of the local officer, concurred in by the division engineer, the improvement proposed is not recommended at this time. The reports were transmitted to Congress and printed in House Doc. No. 362, Fifty-sixth Congress, first session. (See also Appendix L L 25.)

5. *Preliminary examination of harbor at Two Rivers, Wis.*—Captain Warren submitted report April 18, 1899. It is his opinion, concurred in by the division engineer and by me, that the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 45, Fifty-sixth Congress, first session. (See also Appendix L L. 26.)

6. *Preliminary examination and survey of Manitowoc Harbor, Wisconsin.*—Captain Warren submitted reports dated April 18 and December 12, 1899, respectively, with plan for improvement at an estimated cost of $37,000, and it is the opinion of the local officer, concurred in by the division engineer, that the present and pros-

pective commerce justifies the proposed improvement. The reports were transmitted to Congress and printed in House Doc. No. 233, Fifty-sixth Congress, first session. (See also Appendix L L 27.)

7. *Preliminary examination of harbor at Port Washington, Wis.*—Captain Warren submitted report April 18, 1899. It is his opinion, concurred in by the division engineer and by me, that the locality is not worthy of improvement further than is contemplated by existing project. The report was transmitted to Congress and printed in House Doc. No. 44, Fifty-sixth Congress, first session. (See also Appendix L L 28.)

8. *Preliminary examination of harbor at Kenosha, Wis.*—Captain Warren submitted report April 18, 1899. The harbor is now under improvement by the General Government, and the local officer is of opinion that it would be advisable to defer until completion of existing project any survey with a view to enlarging the basin. His views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 46, Fifty-sixth Congress, first session. (See also Appendix L L 29.)

9. *Preliminary examination and survey of Waukegan Harbor, Illinois.*—Captain Warren submitted reports dated April 18, 1899, and January 5, 1900, respectively, with plan for improvement at an estimated cost of $345,000, and states that he considers the locality worthy of improvement by the General Government. His views are concurred in by the division engineer and by me. The reports were transmitted to Congress and printed in House Doc. No. 343, Fifty-sixth Congress, first session. (See also Appendix L L 30.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Manitowoc Harbor, Wisconsin, with a view of making a harbor of refuge with a depth of not less than 20 feet.*
2. *Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin, with a view to deepening the canal to 18 feet; said improvement to begin at the Lake Michigan end of said waterway and to continue throughout the length of said canal and in the waters of Sturgeon Bay, so far as is necessary to secure a navigable channel having a depth of 18 feet of water from Lake Michigan to the waters of Green Bay.*
3. *Milwaukee Harbor, Wisconsin, with a view to necessary enlargement and suitable protection therefor.*

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS AND CHICAGO AND ILLINOIS RIVERS, ILLINOIS, AND CALUMET RIVER, ILLINOIS AND INDIANA; ILLINOIS AND MISSISSIPPI CANAL.

This district was in the charge of Maj. W. L. Marshall, Corps of Engineers, to December 31, 1899, and of Maj. J. H. Willard, Corps of Engineers, since that date. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Chicago Harbor, Illinois.—The present project was adopted in 1870 and modified in 1878, and contemplated—

(*a*) The formation of an outer harbor or basin by inclosing a portion of Lake Michigan just south of the entrance to Chicago River by breakwaters, and dredging the same, for the purpose of increasing the harbor facilities of Chicago.

(*b*) The construction of an exterior breakwater in deep water in Lake Michigan north of the entrance to Chicago River and about 1 mile distant therefrom, to shelter the approaches to the river and outer harbor and to form a harbor of refuge near the southern end of Lake Michigan.

(*c*) To keep the entrance to Chicago River dredged for the passage of vessels navigating Chicago River as far as to the original shore line of Lake Michigan, at or near Rush Street Bridge.

The river and harbor act of March 3, 1899, further modified the project of 1870 by providing for dredging the outer basin and harbor entrance to 20 feet depth at low water.

There had been expended upon this project up to June 30, 1899, $1,802,571.55, including $25,000 allotted from the appropriation of August 18, 1894, for dredging Chicago River, of which amount $3,645.70 was expended for dredging from the mouth of the river to Rush Street Bridge and $21,354.30 applied to dredging the river from its mouth to the stock yards, on the South Branch, and to Belmont avenue, on the North Branch.

All of the work under the projects of 1870–1878 has been done, except dredging the outer basin, and the piers, breakwaters, and channel have been maintained in good order.

The piers at the entrance to Chicago River, the exterior breakwater, and the breakwaters of the outer basin are now in good condition, except about 500 linear feet of superstructure over the southerly breakwater, outer basin, which will soon need rebuilding.

All of the old piers near the mouth of Chicago River now within the shore line have been practically abandoned by the United States as forming part of the bulkheads or wharves of Chicago River, except that portion of the south pier forming the north limit of the Illinois Central Railroad docks.

The outer basin continues to fill in, and in its present condition is useless as a roadstead, except for small vessels drawing less than 12 feet of water.

Under the provisions of the river and harbor act of March 3, 1899, proposals for dredging the outer basin and entrance to Chicago River were received and a contract entered into. This contract provided for the dumping of dredged material south of the outer harbor not less than 2½ miles from shore, or south of Sixteenth and north of Thirty-ninth streets inshore from a line parallel to the shore line and 1,000 feet therefrom, which included the dumping grounds designated by the Secretary of War August 30, 1897, under authority conferred by the act of Congress approved September 19, 1890.

The action of the Secretary of War in designating these dumping grounds was taken after thorough consideration and with the assent of the authorities of the city of Chicago.

Before work had begun on this contract, however, the city authorities withdrew their assent to dumping within the limits designated and issued an order forbidding all dumping in Lake Michigan within 8 miles of the shore line between the north limits of the city and the Indiana State line. It was held by the Attorney-General that they had no legal power to prohibit Government contractors on the work of improving Chicago Harbor from depositing dredged material within the area designated therefor by the Secretary of War. It became evident, however, that if work under this contract was proceeded with, it could only be done at greatly increased cost to the United States for towing the dredged material a distance of 8 miles, or after issue of a legal contest with the city. As the issue of such a contest would likely be long deferred, and the delay would not only prove embarrassing to the Government, but afford the contractor grounds for damage claims, it was believed that the public interests would be better served by abrogating so much of the contract as related to dredging. The contractor having expressed a desire to be relieved from this portion of his obligation, and having made application therefor, the Secretary of War approved the application, and a supplementary contract was entered into, annulling the original contract so far as related to dredging.

The refilling of breakwaters with stone and construction of six clumps of piles was completed June 20 and the contract closed.

July 1, 1899, balance unexpended	$108,058.61
June 30, 1900, amount expended during fiscal year	5,183.00
July 1, 1900, balance unexpended	102,875.61
July 1, 1900, amount covered by uncompleted contracts	1,100.00
July 1, 1900, balance available	101,775.61
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	100,000.00

(See Appendix M M 1.)

2. *Chicago River, Illinois.*—This river, as far as its navigable water extends, is entirely within the limits of the city of Chicago, Ill. Prior to the act of June 3, 1896, no work had been done for the improvement of its navigation by the United States. The present project, inaugurated by Congress under the act of June 3, 1896, as modified by the act of June 4, 1897, contemplates the improvement of the river by dredging and minor changes of docks and dock lines to admit passage by vessels drawing 16 feet of water.

The depth adopted and authorized has been absolutely determined by the crown of the Washington and LaSalle street tunnels, beyond which depth it is again limited by the Van Buren street tunnel.

The dimensions of vessels, other than depth of hold and draft, is further limited by the bridges, bends, and width between docks.

The river and harbor act of August 18, 1894, allowed $25,000 from the appropriation made for the improvement of Chicago Harbor to be applied to the improvement of Chicago River between the mouth of the river and the junction of the two branches, of which amount $3,645.70 was expended in the year ending June 30, 1896, in dredging to 18 feet depth as far as to Rush Street Bridge. Since the passage of the act of June 3, 1896, the balance of this amount has been transferred to the Chicago River work.

Up to the close of the fiscal year ending June 30, 1899, there had been expended in dredging Chicago River $176,114.49, excluding the $25,000 allotted as above stated, as a result of which expenditure the river has been dredged to a depth of 17 feet below Chicago city datum, from the mouth of the river to Ashland avenue on the South Branch and West Fork, and to the stock yards on the South Fork, South Branch, a distance of about 6 miles, and to Belmont avenue on the North Branch, the head of navigation.

During the fiscal year there was dredged from the North Branch 93,591 cubic yards.

In all there have been dredged under this project from the South Branch 628,991 cubic yards, and from the North Branch 1,244,918 cubic yards, or a total of 1,873,909 cubic yards.

Under the provisions of the sundry civil act of June 4, 1897, and under the appropriation made by the sundry civil act of July 1, 1898, a contract has been made for all the work under the project of August 9, 1893, of widening and docking the river at certain points. The lands needed for the improvement were appraised by a board of three real estate experts, and their estimates of values have been accepted by owners where no material damage and obstruction to business is in question. Titles have been secured to all but three of the tracts to be removed at a total cost, including damages, of $88,666.25, and eight tracts have been improved.

July 1, 1899, balance unexpended	$386, 885. 51
Amount appropriated by sundry civil act approved June 6, 1900	62, 000. 00
	448, 885. 51
June 30, 1900, amount expended during fiscal year	170, 444. 05
July 1, 1900, balance unexpended	278, 441. 46
July 1, 1900, amount covered by uncompleted contracts	72, 243. 60
July 1, 1900, balance available	206, 197. 86
Amount (estimated) required for completion of existing project	75, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	75, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 2.)

3. *Calumet Harbor, Illinois.*—This harbor is known on the Great Lakes as South Chicago Harbor.

This improvement was designed to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by the construction of parallel piers, 300 feet apart, projecting from the shore into Lake Michigan and by dredging between them.

The work began in 1870, and all the projected work had been accomplished for 16-foot draft prior to June 30, 1896, resulting in the construction of 3,640 linear feet of north pier and 2,020 linear feet of the south pier, and securing and maintaining a channel 16 feet deep and of suitable width from similarly deep water in Lake Michigan to the Calumet River at the roots of the piers, at a cost of $454,483.53. The work included also 476,564 cubic yards of material dredged, increasing the depth in the channel from 7 to 16 feet.

On June 30, 1896, it may be considered that the original project for this locality was terminated and completed.

On June 30, 1895, a further project, based upon a survey ordered by the river and harbor act of August 18, 1894, was submitted for the further improvement of this harbor, contemplating the extension of the south pier 1,200 linear feet, of the north pier 500 linear feet, and the dredging of a channel to 20 feet depth at low water, all at an estimated cost of $154,550. (Annual Report of the Chief of Engineers for 1895, p. 2771.)

Later, upon a further call of this office, the local engineer, under date of February 21, 1896, submitted a report, in which he presented a plan for improvement of both the inner and outer harbors. The estimated cost of this improvement was $1,134,830. (Annual Report of the Chief of Engineers for 1896, p. 2583.)

The act of June 3, 1896, in appropriating for Calumet Harbor, includes the amended project of June 30, 1895, but in appropriating for Calumet River adopts the project of February 21, 1896, in so far as relates to the 20-foot channel in harbor and river.

Under these projects there has been expended $89,013.12. The total expenditures to June 30, 1899, were $524,626.26.

Both works, namely, the extension of the south pier 800 linear feet and dredging the channel from deep water in the lake to a similar depth of 20 feet in Calumet River, have been done.

The old work is now in good condition, except 500 linear feet of superstructure and the revetment west of the Illinois Steel Company's slip.

The river and harbor act of March 3, 1899, provides as follows:

> Improving Calumet Harbor, Illinois, according to the project of February twenty-first, eighteen hundred and ninety-six: Continuing improvement, one hundred and fifty thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete said project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and fifty-nine thousand eight hundred and thirty dollars, exclusive of the amount herein and heretofore appropriated.

Congress thus definitely authorized the project of February 21, 1896, for the construction of the outer harbor of refuge. Construction of the outer breakwater, 4,400 feet in length, has been put under contract, foundation prepared for a distance of 1,000 feet, 13 cribs, 18 courses in height, constructed, and 8 cribs sunk in place and filled with stone.

July 1, 1899, balance unexpended	$162, 773. 74
Amount appropriated by sundry civil act approved June 6, 1900	185, 350. 00
	348, 123. 74
June 30, 1900, amount expended during fiscal year	18, 875. 39
July 1, 1900, balance unexpended	329, 248. 35
July 1, 1900, amount covered by uncompleted contracts	308, 335. 11
July 1, 1900, balance available	20, 913. 24
Amount (estimated) required for completion of existing project	674, 480. 00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	300, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix MM 3.)

4. Calumet River, Illinois and Indiana.—The project for the improvement of this river, adopted by Congress in 1883, contemplated securing a channel 200 feet in width and 16 feet in depth below low water in Lake Michigan, from the mouth of Calumet Harbor, Illinois, to one-half mile east of Hammond, Ind., with a view to increasing the facilities for handling the commerce of this region and also aiding in providing means for the better accommodation of much of the commerce of Chicago River, which river was and still is much crowded.

The original depth in Calumet River varied between 6 and 10 feet.

Following a report on a survey of Calumet Harbor, Illinois, published as House Doc. No. 277, Fifty-fourth Congress, first session, also published in the Annual Report of the Chief of Engineers for 1896, page 2583, the project has been modified by the river and harbor act of June 3, 1896, so far as to allow the channel for 2 miles southward from the mouth of the river to be dredged to 20 feet depth.

This modification increases the estimated cost of the improvement by $51,700.

Since the improvement began in 1889 there has been dredged a channel, measured from the harbor southward, to the full width of 200 feet and depth of 16 feet, 19,518 feet in length, except that over a short portion where rock was encountered the width was reduced to 85 feet, 9,000 cubic yards or less of rock remaining to be removed to secure the full width and depth over this short stretch.

Under the 16-foot project 1,767,220 cubic yards of material was removed prior to June 30, 1896, from the channel below the forks of the Calumet. In addition there has been removed 248,516 cubic yards of material from the channel between the forks and one-half mile east of Hammond, Ind., in an effort to secure a practicable channel 10 feet deep and 60 feet wide, resulting in failure, due to rapid refilling of channel by slaughterhouse refuse, sewage, and other filth.

The amount expended by the United States on this original project prior to June 30, 1896, was $291,842.07, of which $248,715.91 had been expended below the forks, and $43,126.16 for work between the forks and one-half mile east of Hammond, Ind.

The river and harbor act of 1896 appropriated $50,000 and authorized dredging the channel to 20-foot depth for 2 miles southward from the mouth, and under this supplementary and restricted project there has been 320,405 cubic yards of material removed under contract, completing the channel 20 feet deep a distance of 2 miles, at a further cost of $50,276.35.

The total expenditures to June 30, 1899, amounted to $342,746.15.

A winding or turning basin 20 feet deep, of sufficient dimensions for the largest lake vessels yet constructed, was also dredged at the first cut-off above the mouth of the river.

The amount appropriated by the act of June 3, 1896, was found sufficient to dredge the channel to the 2-mile limit and provide the basin named at somewhat less cost than estimated February 21, 1896, due to the favorable terms secured for the work.

Similar winding or turning basins should be provided at intervals of from 1 to 2 miles along the river, to avoid in future the restrictions now imposed in other lake harbors within the shore lines.

The river and harbor act of March 3, 1899, appropriated $60,000 for the improvement of this stream, and confines the work to the section of the river between the mouth and the forks of the Calumet.

This work was let to contract, and during the year 179,655 cubic yards of material was removed, improving the channel for a distance of 6,700 feet.

July 1, 1899, balance unexpended	$67,253.85
June 30, 1900, amount expended during fiscal year	23,078.28
July 1, 1900, balance unexpended	44,175.57
July 1, 1900, amount covered by uncompleted contracts	30,172.63
July 1, 1900, balance available	14,002.94
Amount (estimated) required for completion of existing project	640,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 4.)

5. *Illinois River, Illinois.*—The present project was adopted in 1880, and contemplates the extension of the slack-water improvement begun by the State of Illinois from Copperas Creek locks to the Missisipi River, a distance of 135 miles.

The project includes the construction of two locks, 350 feet long between miter sills, 75 feet width of chamber, with 7 feet of water over sills at low-water level of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water in the pools thus created.

The two locks and dams are completed and in use. One is situated at Kampsville, 31 miles above the mouth of the Illinois River, the other at Lagrange, 79 miles above the mouth of the Illinois River.

The ultimate object of the improvement is the construction of a waterway from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River steamboats and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of the project by the construction of two locks of the dimensions given—one at Henry and one at Copperas Creek—completing, except dredging, that part of the improvement between Lasalle, Ill., and the mouth of Copperas Creek, a distance of about 90 miles.

In executing this work the United States had expended up to June 30, 1899, $1,365,927.06, including $25,000 from the appropriation of August 11, 1888, for surveys, and excluding $62,359.80 expended upon a foundation for Copperas Creek Lock, afterwards completed by the State of Illinois.

An additional amount of $747,747 was expended by the State of Illinois at Henry and Copperas Creek locks and dams.

During the year work of dredging has been confined to bars between Kampsville and Six-mile Island Bar, a distance of 23.7 miles, and 247,043 cubic yards of material was removed, completing a channel 200 feet wide at Twelve-mile Island Bar, and a channel 150 feet wide and about 8,500 feet long at French Bar; 10 snags removed from channel; two new scows constructed; temporary machine shop erected and lathe and drill press set up; work on machine-shop barge begun, and all floating plant overhauled and put in good repair. The grounds above lock-keepers' houses at Kampsville and Lagrange locks were raised above ordinary high water, 12,210 cubic yards of earth being used.

July 1, 1899, balance unexpended	$95,446.15
June 30, 1900, amount expended during fiscal year	36,187.72
July 1, 1900, balance unexpended	59,258.43
July 1, 1900, outstanding liabilities	4,000.00
July 1, 1900, balance available	55,258.43
Amount (estimated) required for completion of existing project	257,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 5.)

6. *Operating and care of Lagrange and Kampsville locks, Illinois River, and approaches thereto.*—These locks and dams have been operated and maintained under the indefinite appropriation provided for in section 4 of the river and harbor act of July 5, 1884.

Lagrange lock and dam.—The works were operated and cared for during the year. Houses were painted and new foundation put under watchhouse. The renewal of the woodwork of the lower gate was completed.

Between March 15 and May 5, during high water, all boats passed over the dam except nine loaded barges and a few small steamers, which did not have sufficient power to take them over the dam.

The tonnage passing shows a slight decrease due to shortage of crops.

The amount expended during the year was $5,692.07 exclusive of $450.98 outstanding liabilities June 30, 1900.

Kampsville lock and dam.—Operated and maintained by hired labor during the year. One hundred and thirty-five cubic yards of mud was dredged from about the ways, 70 cubic yards removed from head bay of lock, and 66 yards removed from above lower gate; stone foundation built under office; watchhouse painted inside and covered with new canvas roof; 60 linear feet of coping of dam relaid and stringers fastened down.

No boats passed this lock from December 4, 1899, to March 9, 1900, and from this date until April 23 all boats, except one steamboat and one tow of ice, passed over the dam.

While the tonnage of steamboats passing the lock is greater than that of any previous year, the combined tonnage of steamboats and barges is lower than any except the first year, due to the light ice harvest, which is taken out wholly in barges.

The amount expended during the year, exclusive of $442.40 outstanding liabilities, was $6,533.08.

(See Appendix M M 6.)

7. *Illinois and Mississippi Canal, Illinois.*—The object of the improvement is to furnish a link in a navigable waterway from Lake Michigan to the Mississippi River at the mouth of Rock River, Illinois.

The canal has been located on the Rock Island route, approved by the Secretary of War October 27, 1888, as directed in the act of Congress of August 11, 1888. It proceeds from the Illinois River at its great bend, 1¾ miles above the town of Hennepin, Ill.; thence via Bureau Creek Valley and over the summit to Rock River at the mouth of Green River; thence, by slack water in Rock River and a canal around the lower rapids of the river at Milan, to the Mississippi River at the mouth of Rock River.

The canal is to be at least 80 feet wide at the water surface, 7 feet deep, and with locks 170 feet long and 35 feet width of lock chamber, capable of passing barges carrying 600 tons (maximum) freight.

A report upon the location, with detailed estimates of cost, of this canal was submitted June 21, 1890, and published (without maps) as House Ex. Doc. No. 429, Fifty-first Congress, first session, and is also printed in the Annual Report of the Chief of Engineers for 1890, page 2586.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of the canal and directed work to be begun by the construction of one of the locks and dams in Rock River.

In accord with this act work was begun in July, 1892, near the mouth of Rock River, on the construction of a canal around the lower rapids of the river, and since that date has been prosecuted as rapidly as appropriation of funds permitted. The survey work, in locating the canal on the ground, and proceedings for acquiring title to the right of way have been continuous since October, 1890, and the canal has been definitely located on the ground throughout its entire extent.

There had been expended on this work up to the close of the fiscal year ending June 30, 1899, $2,605,106.91, and during the fiscal year ending June 30, 1900, $913,690.95.

The result of this expenditure has been:

First. The acquisition of the right of way for 4½ miles around the lower rapids of Rock River and the completion of 4½ miles of canal there, involving the construction of 4½ miles of earthwork in constructing the canal trunk, 3 locks, 1 railroad and 2 highway swing bridges, 7 sluiceways and gates, 1 arch culvert, 2 dams 1,392 feet long across the arms of Rock River, 3 lock-keepers' houses, 1 small office building, a thorough riprapping of the canal banks, not estimated for in the original estimates, and construction, by contract, of Moline Wagon Bridge across Rock River at a cost of $25,000, which was also not included in original estimate.

Second. In the location on the ground and preparation of descriptions, plats, and abstracts of title of all land needed for the construction of the canal and feeder, and for lands to be overflowed or damaged by the dam at Sterling.

Third. In the completion of all earthwork, miles 1 to 18, except reenforcing high embankments and filling behind the walls of Lock 21 and approaches to highway bridges 5 and 7; the foundation and masonry for all culverts, Locks 1 to 21, aqueducts 1, 2, and 3, highway bridges 1 to 10, two railroad bridges at crossings on miles 2 and 7; the erection of superstructure of 2 aqueducts, one double-track and one single-track railroad bridge, and 6 highway bridges; the construction of 7 arch culverts and 10 pipe culverts; the partial completion of earthwork on miles 19, 20, and 24 to 28, inclusive; the erection of 5 houses for superintendents and lock keepers, and the placing under contract of 1 double-track railroad bridge and 5 highway bridges, all on eastern section.

Fourth. In the acquisition by purchase or condemnation of all lands required for eastern section along the line originally contemplated; all of feeder; the condemnation of all on western section and of all lands to be affected by overflow; the acquisition by purchase of all lands on western section except 6 miles, and of all excepting one-fourth of lands to be damaged by overflow.

Fifth. In the putting under contract of earthwork of all the feeder line and of all the pipe culverts and of all arch culverts under the feeder except one, and in the construction of 3,259,602 cubic yards of earthwork along the feeder, resulting in the completion of all earthwork along 9 miles and 60 per cent of earthwork along the remaining 20 miles, and in constructing 9 pipe culverts under bridge approaches along the feeder; in the completion of the foundations of 4 arch culverts, the completion of 4 pipe culverts, and the partial completion of 5 pipe culverts, all under the feeder.

During the fiscal year ending June 30, 1900, the following work has been done:

Hired labor.—Eastern section.—Earthwork on miles 24 and 25 about 35 per cent completed; the lining of 7 miles of canal trunk with watertight material where required was nearly completed; abutments and approaches to 5 highway bridges (Nos. 5, 6, 7, 8, 9) completed, and abutments and approaches to Nos. 16, 17, and 18 under way; abutments for 2 railroad bridges completed, and for 1 other in course of construction; arch culverts Nos. 1 to 7 of concrete masonry completed, and one 12-inch cast-iron pipe culvert on mile 2 completed except flushing arrangement; superstructure of 2 aqueduct bridges erected.

Feeder.—Concrete masonry deposited for 2 10-foot and 2 12-foot arch culverts; forms erected and concrete deposited for 3 highway bridges and in part for 2 others; towpath built of concrete at bridge 44, and of rubble masonry at 4 others.

Western section.—One warehouse built and plans and specifications for 4 others prepared; miles 30 to 48, inclusive, except portion of 31. fenced; about 20 miles of right of way staked out, slope stakes set, and quantities of earthwork for about 12 miles computed; 2 culvert pits excavated.

By contract.—Eastern section.—Under contract with the Globe Construction Company, mile 19 is about 98 per cent complete, of which about 9 per cent was done during the year, and mile 20 about 51 per cent complete, of which about 9 per cent was done during the year. Nothing was done on miles 21, 22, and 23. The contract of this company, which covered 5 miles of earthwork (19 to 23, inclusive), expired by limitation on September 30, 1899, without the completion of 1 mile out of the 5. The contractors are reported as having at no time maintained a sufficient force or plant to complete the work.

Under contract with Katz & Callahan 45 per cent of earthwork on miles 26 to 28, inclusive, was executed. The superstructure of 5 highway, 1 single track, and 1 double-track railway bridge completed, and superstructure for 3 aqueduct bridges delivered.

Feeder.—2,480,867 cubic yards of earthwork was executed, completing all earthwork on 9 miles and about 60 per cent of the remaining 20 miles. Under contract with the Callahan Construction Company for constructing foundation for 7 arch culverts and constructing 10 pipe culverts, work progressed slowly until December 31, 1899, at which time the contract expired, the contractors through oversight having neglected to apply for an extension. Since that time work has been proceeding under an implied contract at original contract prices. Foundations for 4 arch culverts were completed; 4 pipe culverts completed and pits for 5 more partly excavated.

Western section.—About 12 miles of canal trunk was placed under contract and 414,773 cubic yards of earthwork executed.

July 1, 1899, balance unexpended		$1,633,419.55
Amount appropriated by sundry civil act approved June 6, 1900		1,000,000.00
		2,633,419.55
June 30, 1900, amount expended during fiscal year		913,690.95
July 1, 1900, balance unexpended		1,719,728.60
July 1, 1900, outstanding liabilities	$86,463.27	
July 1, 1900, amount covered by uncompleted contracts	458,585.38	
		545,048.65
July 1, 1900, balance available		1,174,679.95
Amount (estimated) required for completion of existing project		1,733,490.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix M M 7.)

8. *Operating and care of Illinois and Mississippi Canal; canal around lower rapids of Rock River, at Milan, Ill.*—This canal is 4½ miles in length, surmounting a fall of 18 feet, and the works operated and cared for include 3 locks, 3 swing bridges, 7 sluiceways, 1 arch culvert, 3 lock houses, 1 office building, and 2 dams.

The canal was formally opened to navigation April 17, 1895.

The canal and works have been operated and maintained during the year; lower entrance to Lock 37 dredged; retaining walls at guard lock strengthened by increasing the thickness of the walls with natural cement concrete; and railway and highway bridges painted.

The Moline Wagon Bridge was completed.

During the season of navigation boats and barges aggregating 109,246 tons passed the canal, carrying 18,682 tons of coal and 1,871 passengers, showing an increase for the year compared with the preceding year.

There was expended during the year ending June 30, 1900, $5,379.84, exclusive of $267.15 outstanding liabilities.

(See Appendix M M 8.)

9. *Survey of Upper Illinois and Lower Desplaines rivers, Illinois, with a view to the extension of navigation from the Illinois River to Lake Michigan at or near Chicago, Ill.*—A survey party was put in the field July 14, 1899, and employed for some weeks in special surveys between the Sag and Calumet and locating new works between Chicago and Joliet. On August 9 the regular survey of the river was begun, and the field work of this completed November 20. This survey was planned to cover the river and bottoms on each side within the high-water limits, taking the topography of this in such detail as to cover the ground with foot contours.

In the spring of 1900 river observations were commenced. Gauges were set along the course of the river and discharges taken in the characteristic reaches. A special survey of the Illinois and Michigan Canal from Joliet to below the mouth of the Kankakee River was also made. The field work of this was completed June 30, 1900.

In the office, the regular survey from Lockport to Lasalle has been all plotted, the foot contours worked out, and the greater part of it is now inked in. The special survey between Sag and Calumet has been reduced, but is still to be plotted.

Preliminary report by the Board of Engineers was submitted March 17, 1899. It was transmitted to Congress and printed in House Doc. No. 548, Fifty-sixth Congress, first session, and is herewith.

July 1, 1899, balance unexpended	$29,490.37
June 30, 1900, amount expended during fiscal year	16,981.33
July 1, 1900, balance unexpended	12,509.04
July 1, 1900, outstanding liabilities	730.28
July 1, 1900, balance available	11,778.76

(See Appendix M M 9.)

EXAMINATION AND SURVEY OF CHICAGO RIVER, ILLINOIS, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of *Chicago River, Illinois, with a view to obtaining a channel 21 feet deep from its mouth to the stock yards, on the South Branch, and to Belmont avenue, on the North Branch*, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. W. L. Marshall, Corps of Engineers, and reports thereon dated September 14 and November 14, 1899, submitted through the Division Engineer, Col. J. W. Barlow, Corps of Engineers. The plan for improvement presented is estimated to cost $810,600, and the locality is deemed by the local officer and the division engineer to be worthy of improvement to the extent indicated in the act. The reports were transmitted to Congress and printed in House Doc. No. 95, Fifty-sixth Congress, first session. (See also Appendix M M 10.)

EXAMINATION OF ROCK RIVER, ILLINOIS, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Rock River, Illinois, at the head of the feeder for the Illinois and Mississippi Canal, with a view to the construction of a lock and dam in connection with said canal*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF MICHIGAN CITY HARBOR, INDIANA, AND OF RIVERS AND HARBORS ON THE EASTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Capt. Chester Harding, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. *Michigan City Harbor, Indiana.*—The improvement of this harbor dates from 1836, and has resulted in establishing an inner harbor for local commerce, and partly completing an outer harbor, designed to facilitate entrance to the former and afford refuge in times of northerly gales to vessels engaged in general lake commerce.

The inner harbor has been made by deepening the entrance to Trail Creek and protecting the channel by piers extending to deep water in Lake Michigan, to which operations were limited until 1870, and prolonging the entrance channel up the creek by dredging between revetments as they are built on established dock lines at the expense of the adjoining property, as required by city ordinance. This latter work was commenced in 1882, and the total length of the interior waterway dredged out is 9,159 feet between revetments from 100 to 175 feet apart, except at the turning basins, where the width is about 350 feet.

The total expenditure to June 30, 1899, was $430,572.27, at which date the channel depths were 13 feet and more from the harbor entrance to the railroad bridge, a distance of about 4,700 feet, above which point there was 12 feet available water with slightly less in some places. Operations during the year were confined to the completion of the dredging for maintenance in progress at the beginning of the year, and to minor repairs to the south pier. No dredging was found to be necessary after the opening of navigation in 1900. The harbor structures aggregate 3,563 feet in length, of which a length of 735 feet is in need of extensive repairs, and 1,373 feet require sheet piling. Provision should be made for maintaining the required depth of channel by dredging.

July 1, 1899, balance unexpended	$8,686.50
June 30, 1900, amount expended during fiscal year	5,143.05
July 1, 1900, balance unexpended	3,543.45
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	48,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

The outer harbor.—This part of the improvement was commenced in 1870 under a project which provided for making an outer basin east of the entrance to the inner harbor; in 1882 this project was extended to include the construction of an exterior breakwater northwest of the entrance. The piers and breakwaters covering the outer basin were completed in 1885 and have a total length of 3,141 feet, viz, a pile pier 1,225 feet long, extending in a northerly direction from the shore and closing the basin on the east; a crib breakwater 1,411 feet long, extending westward from the lake end of the pile pier and closing the basin on the north, and a crib pier, 505 feet long, extending northward from the west end of the crib breakwater. The exterior breakwater contemplated by the project of 1882 was to have a total length of 2,000 feet, but a length of only 700 feet has been built.

The river and harbor act of March 3, 1899, authorized the adoption of the project of the Board of Engineers as printed in the Annual Report of the Chief of Engineers for 1897, pages 2899 to 2904, inclusive, and provided for the completion of the work under the continuing-contract system. This project requires the extension of the breakwater pier by 600 feet, the construction of a new detached breakwater 1,500 feet long, and the removal of the present detached breakwater. Operations are in progress under a contract for the completion of all the work contemplated in the project except one crib 100 feet long in the new detached breakwater. Funds are available for the completion of the contract.

The total amount expended on this improvement to June 30, 1899, was $755,983.45.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	1,153	208,617	1894	389	119,929
1889	795	169,193	1895	343	91,016
1890	921	172,817	1896	437	106,543
1891	837	168,654	1897	492	118,137
1892	1,391	443,065	1898	478	127,237
1893	1,577	589,863	1899	601	144,880

Maximum draft, 14 feet.

NOTE.—No record is kept at Michigan City of traffic between this port and Chicago.

July 1, 1899, balance unexpended		$85,891.55
Amount appropriated by sundry civil act approved June 6, 1900		195,000.00
		280,891.55
June 30, 1900, amount expended during fiscal year		2,050.39
July 1, 1900, balance unexpended		278,841.16
July 1, 1900, outstanding liabilities	$272.20	
July 1, 1900, amount covered by uncompleted contracts	257,000.00	
		257,272.20
July 1, 1900, balance available		21,568.96
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		15.000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix N N 1.)

2. *St. Joseph Harbor, Michigan.*—The improvement of the mouth of St. Joseph River was commenced more than sixty years ago, when there was a narrow and crooked channel with depths fluctuating between 3 and 7 feet. The work then commenced has developed the present harbor at this place, the entrance to which is between piers 270 feet apart. The north pier is 2,017 feet long, and all but a length of about 455 feet is now in good condition. The south pier is 819 feet long; it is in a dilapidated condition, due to age, and its reconstruction is now in progress under a contract to be completed September 1, 1900.

Until 1899 the approved project of improvement called for a navigable depth of 16 feet from Lake Michigan into and through St. Joseph Harbor, and of 13 feet from the upper end of that harbor, which is at the confluence of the St. Joseph and Paw Paw rivers, to Benton Harbor, via the Benton Harbor Canal. The required depth of 16 feet has not yet been obtained at the harbor's entrance, because the piers do not extend sufficiently into Lake Michigan. The river and harbor act of March 3, 1899, approved the amended project printed in the Annual Report of the Chief of Engineers for 1898, page 2494, which enlarged the scope of the improvement to accommodate the increasing commerce at this harbor, and, besides the necessary repairs to existing piers, provided for an extension of the north pier to the 20-foot contour, extension of the south pier to the 18-foot contour, dredging the harbor at its entrance and for a width of 150 feet along the city front of St. Joseph to a depth of 18 feet, and dredging the Benton Harbor Canal and a turning basin at the mouth of the St. Joseph River to a depth of 15 feet. The estimated cost of this work is $380,000.

The same act placed the work under the continuing-contract system. Operations are in progress under a contract for the pier extensions contemplated by the project, and funds are available for the completion of the contract. The dredging remains to be provided for. The total expenditure for improvements and maintenance at this harbor to June 30, 1899, was $496,864.31, at which date there existed an available channel of a depth of 13 feet or more. Operations during the year have included extensive repairs to a portion of the south pier, preparations for the pier extensions under contract, and dredging for maintaining the required channel depths. As a result of the dredging, a practicable channel of 13.5 feet depth was restored throughout the main channel from the entrance to Benton Harbor.

Entrances and clearances.

Calendar year.	Vessels entered.		Vessels cleared.	
	Number.	Tonnage.	Number.	Tonnage.
1890	948	131,607	946	131,395
1891	742	215,334	743	215,591
1892	1,726	707,285	1,727	707,785
1893	1,576	1,125,063	1,575	1,125,938
1894	1,100	900,000	1,100	900,000
1895	779	327,384	727	327,837
1896	835	439,031	833	435,033
1897	842	385,915	849	348,040
1898	948	1,216,567	943	1,114,560
1899	853	446,178	851	430,411

Maximum draft, 14 feet.

July 1, 1899, balance unexpended		$46,247.89
Amount appropriated by sundry civil act approved June 6, 1900		253,950.00
		300,197.89
June 30, 1900, amount expended during fiscal year		15,658.64
July 1, 1900, balance unexpended		284,539.25
July 1, 1900, outstanding liabilities	$45.29	
July 1, 1900, amount covered by uncompleted contracts	268,605.93	
		268,651.22
July 1, 1900, balance available		15,888.03
Amount (estimated) required for completion of existing project		54,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$38,000.00	
For maintenance of improvement	15,000.00	
		53,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 2.)

3. *St. Joseph River, Michigan.*—This is a crooked stream, obstructed by numerous shoals, with depth in channel crossings of from 24 to 30 inches. The intervening pools are generally from 4 to 8 feet deep. The part under improvement is from the mouth, at St. Joseph, to Berrien Springs, a distance of about 25 miles by river. The improvement of this section to make a low-water channel 3 feet deep has been in progress since 1889, and consists in removing snags and logs and closing secondary channels, or concentrating the flow at other critical points by dams of brush, logs, and stone.

The amount expended to June 30, 1899, was $5,483.66, as a result of which many of the worst places of the stream had been improved to the required extent.

There were no operations in progress during the year, on account of the exhaustion of funds.

The cost of completing an improvement of this character depends entirely on how long the work is to be kept up and the annual cost of doing it. In the present case the average annual expenditure has been $500, and experience shows that it is too little to accomplish what is required for making and maintaining the limited improvement.

Commercial statistics for calendar year 1899.—The steamers *May Graham* and *Tourist* carried 21,000 passengers and 2,353 tons of miscellaneous freight between St. Joseph and Berrien Springs. The boats draw 34 and 30 inches, respectively.

July 1, 1899, balance unexpended	$16.34
June 30, 1900, amount expended during fiscal year	6.45
July 1, 1900, balance unexpended	9.89
Amount (estimated) required for completion of existing project	5,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	700.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix N N 3.)

4. *South Haven Harbor, Michigan.*—This harbor is the result of improvements made at the mouth of Black River since 1867. Before any improvement was made the depth was only 3 or 4 feet through a narrow and unstable channel. Two parallel piers have been built into Lake Michigan, with revetments extending from their shore ends for a distance of about 1,000 feet up the stream. A length of 50 feet added to the south pier during the year makes the aggregate length of the piers and revetments 3,145 feet. A channel has been dredged between the piers and revetments and for a further distance upstream of about one-half mile. The width between the piers and revetments is 177 feet, and the stream above that point to the upper limit of the improvement is about 85 feet, with an upper turning basin 100 feet wide. The depth of channel called for by the approved project of improvement is 12 feet, but the piers do not extend far enough into Lake Michigan for that purpose, and a depth of 10 feet is all that can be had at entrance, except when a temporary increase is provided by dredging.

The total expenditure to June 30, 1899, was $246,716.13, resulting in the construction and maintenance of the piers and revetments and in repeated dredgings of the channel. Authority was granted to expend a portion of the funds appropriated by the river and harbor act of March 3, 1899, in extending the north pier a distance of 200 feet, thus providing for a part of the needed extensions to at least the 14-foot contour of Lake Michigan. When this is completed all new construction work authorized by the existing project will have been covered, but the navigable depth called for by that project can not be maintained except by considerable annual dredging until further extensions of 100 and 175 feet are made to the north and south piers, respectively.

Operations during the year have comprised: Dredging for the maintenance of the required channel depth of 12 feet, protecting the end of the south pier by sinking a crib 50 feet long, and repairing a length of 1,004 feet of the south revetment. Operations are in progress under a contract for extending the north pier 200 feet and for repairs to the present outer end of the north pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1889 (estimated)	1,080	....	1895	3,222	238,060
1890	2,246	128,880	1896	1,218	343,016
1891	2,994	201,380	1897	1,256	351,000
1892	3,060	212,160	1898	771	322,620
1893	3,822	251,730	1899	682	276,117
1894	3,246	228,246			

Maximum draft, 11.5 feet.

July 1, 1899, balance unexpended		$50,283.87
June 30, 1900, amount expended during fiscal year		18,262.07
July 1, 1900, balance unexpended		32,021.80
July 1, 1900, outstanding liabilities	$220.00	
July 1, 1900, amount covered by uncompleted contracts	29,776.94	
		29,996.94
July 1, 1900, balance available		2,024.86
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 4.)

5. *Saugatuck Harbor, Michigan.*—This harbor is at the mouth of the Kalamazoo River, where the channel depth before improvement was generally not over 5 feet. Its condition was first improved by a private company, which built two slab piers for confining the river current, and thereby obtained a channel depth of 7 feet temporarily. Its further improvement was commenced by the General Government in 1869, and from that time to 1882 the piers were extended and interior channel revetments constructed until they had a total length of 1,907 feet on the north and 3,863 feet on the south side, all of pile work. Since 1882, appropriations having been too small to keep these structures in repair, they have gradually gone to decay, and the navigable channels of 8 feet depth, opened through the harbor from time to time by dredging, fill up again very soon after the departure of the dredge.

The estimates made from time to time for carrying on the work aggregate $175,699.46, and the total expenditure to June 30, 1899, was $167,523.32, with results as indicated in the above paragraph. Operations during the year have been limited to dredging, with the result that a practicable channel of 8 feet depth was available during the navigation season of 1899. The small amount of available funds permitted only a partial relief to the navigation of the harbor upon the reopening of navigation in the spring of 1900.

The port of shipment through this harbor is the town of Saugatuck, 3 miles above the entrance from Lake Michigan, and the natural difficulties of making and maintaining a reliable navigation by the present line of water travel led to an alternative project, which is printed in the Annual Report of the Chief of Engineers for 1896, pages 2741 to 2743. This project was adopted by the river and harbor act of June 3, 1896, and funds have been appropriated under it by that act and the act of March 3, 1899, to the total amount of $15,000.

Until provision is made for carrying out this project, funds will annually be required for maintaining the old harbor of Saugatuck by dredging. (See Kalamazoo River, below.)

An allotment of $2,500 from appropriation by the emergency river and harbor act of June 6, 1900, was made June 30, 1900, for dredging in Saugatuck Harbor.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	262	132,400	1894	862	106,000
1889	314	76,300	1895	1,256	134,948
1890	178	42,000	1896	848	153,190
1891	492	120,000	1897	586	70,360
1892	(a)	(a)	1898	1,329	128,325
1893	626	162,632	1899	1,190	88,236

a Not stated.

Maximum draft, 8 feet.

July 1, 1899, balance unexpended		$6,915.68
June 30, 1900, amount expended during fiscal year		6,347.99
July 1, 1900, balance unexpended		567.69
July 1, 1900, outstanding liabilities	$53.33	
July 1, 1900, amount covered by uncompleted contracts	240.00	
		293.33
July 1, 1900, balance available		274.36
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 5.)

6. *Kalamazoo River, Michigan.*—The project for improving Kalamazoo River is the one referred to above in connection with Saugatuck Harbor. It provides for making a navigable channel 12 feet deep from the town of Saugatuck to Lake Michigan, by dredging the river for a distance of 1¾ miles below the town, and thence making a new cut from the river to the lake. The original estimate for this work was $150,000, and authority was granted on May 31, 1900, to increase the estimate for the completion of the project to $250,000.

A total amount of $15,000 has been appropriated for the work, but as its principal feature is the proposed cut, it would be unwise to enter upon the project until sufficient money is appropriated to excavate it and insure its permanence by constructing the necessary revetments on its sides. For this reason no work has yet been done.

The amount expended to June 30, 1899, was $5.68.

July 1, 1899, balance unexpended	$14,994.32
June 30, 1900, amount expended during fiscal year	13.54
July 1, 1900, balance unexpended	14,980.78
Amount (estimated) required for completion of existing project	235,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	175,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N N 6.)

7. *Holland (Black Lake) Harbor, Michigan.*—The first steps toward establishing a harbor at this place were taken by the citizens of Holland, Mich., by opening a channel having a navigable depth of about 5 feet from the lake into Lake Michigan and protecting it by piers and revetments made of brush and stone. Continuation of this improvement was taken in hand by the General Government in 1867, and existing structures strengthened by pile and crib work, and extended until, in 1880, the north pier and revetment had attained a total length of 1,854 feet and the south pier 1,691 feet. They have remained without extension since that time.

The amount expended to June 30, 1899, was $305,044.91. The results thereby attained have been the construction and maintenance of piers and revetments aggregating 3,545 feet in length, covering a channel way from 175 to 220 feet wide, in which a depth of 12 to 13 feet has been maintained by the aid of dredging. The river and harbor act of March 3, 1899, adopted the modified project printed in the Annual Report of the Chief of Engineers for 1897, page 2950, which provides for extending the north pier 800 feet and the south pier 700 feet, for dredging the channel to a depth of 16 feet, and for repairs of existing structures. Operations during the year have included dredging for the maintenance of the required channel depths, and extensive repairs to an aggregate length of 1,513 feet of the harbor piers and revetments. As a result of the former, a practicable channel 13 feet deep is available for the present season of navigation.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1889	1,087	80,790	1895	809	210,299
1890	(*a*)	(*a*)	1896	408	269,182
1891	2,676	178,300	1897	456	153,852
1892	2,800	200,000	1898	538	163,119
1893	2,060	315,150	1899	527	(*a*)
1894	1,816	159,657			

a Not stated.

Maximum draft, 13.5 feet.

July 1, 1899, balance unexpended		$37,069.21
June 30, 1900, amount expended during fiscal year		33,136.75
July 1, 1900, balance unexpended		3,932.46
July 1, 1900, outstanding liabilities	$412.48	
July 1, 1900, amount covered by uncompleted contracts	321.29	
		733.77
July 1, 1900, balance available		3,198.69
Amount (estimated) required for completion of existing project		202,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		73,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 7.)

8. *Grand Haven Harbor, Michigan.*—This harbor, which is at the mouth of Grand River, had before improvement a shifting channel 9 feet deep. The first step in the line of improvement was taken by the

Detroit, Grand Haven and Milwaukee Railroad Company, by constructing a pier on the south side to provide for the interchange of traffic between the railroad and its translake line of steamers. A systematic improvement was commenced by the Government in 1867, and has resulted in the establishment of a harbor that satisfies the needs of local commerce and also provides a harbor of refuge for general commerce. The total estimated cost of improvements heretofore authorized amounts to $804,366.15, and the total expenditure by the United States to June 30, 1899, was $739,593.14, resulting in building and maintaining an aggregate length of 9,312 feet of piers and revetments and in doing a large amount of dredging for creating and maintaining the required depth of channel. The distance between piers is 420 feet at the entrance, gradually diminishing to 396 feet at the inner end of the revetments. The least actual depth into this harbor on June 30, 1899, was 17 feet.

Operations during the year have been limited to repairs of existing structures. No dredging was found to be necessary.

The approved project provides for an extension of 100 feet to the south pier and of 150 feet to the north pier and for expedients for restraining the drift of sand over the piers and revetments. Funds are available for the extension of 100 feet to the south pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	1,508	1,405,600	1894	641	504,609
1889	1,110	649,370	1895	574	482,822
1890	1,172	834,089	1896	883	727,209
1891	819	616,422	1897	1,151	1,018,805
1892	815	693,835	1898	934	874,312
1893	761	613,425	1899	1,250	1,090,325

Maximum draft, 15 feet.

July 1, 1899, balance unexpended	$29,773.01
June 30, 1900, amount expended during fiscal year	11,220.74
July 1, 1900, balance unexpended	18,552.27
July 1, 1900, outstanding liabilities	44.00
July 1, 1900, balance available	18,508.27
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 8.)

9. *Grand River, Michigan.*—Between 1881 and 1886 the sum of $50,000 was applied to dredging some of the worst bars in the Grand River between Grand Rapids and its mouth, the result of which was to obtain, temporarily, narrow channels through these bars with a navigable depth of about 4 feet. In its original condition the depth in crossings over some of the bars did not exceed 2 feet. No further work was done on the stream until 1896, when a project was adopted which provided for dredging a channel to the depth of 10 feet and

navigable width, the estimated cost being $670,500. Operations under this project were commenced in May, 1897, the immediate plan being to open up a partial channel 6 feet deep and 30 feet wide at bottom, through all bars having a channel depth of less than 5 feet at extreme low water, and from that time until June 30, 1899, 223,087 cubic yards of material had been dredged, and the expenditures to that date were $96,904.96 for fitting up the required plant, doing the dredging above indicated, and constructing contraction works for maintaining the dredged channels. The maximum available depths at the shoalest points of the dredged channels June 30, 1899, varied from 2.8 to 5 feet, except in that made through Deer Creek Bar, 19½ miles below Grand Rapids, where the depth had been reduced to 2.2 feet.

Expenditures during the fiscal year have been applied to maintenance of plant and continuing the work of dredging and dike construction. During the year 88,170 cubic yards of material was removed from the limits of the proposed ultimate channel, and an aggregate length of 12,622 feet of training walls was constructed. On June 30, 1900, the maximum available channel depths over the shoalest portions of the stream, reduced to extreme low water, varied from 2.6 to 5 feet.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1896	282	46,750	1898	76	86,793
1897	77	30,390	1899	323	64,242

July 1, 1899, balance unexpended	$78,095.04
June 30, 1900, amount expended during fiscal year	26,608.16
July 1, 1900, balance unexpended	51,486.88
July 1, 1900, outstanding liabilities	2,988.81
July 1, 1900, balance available	48,498.07
Amount (estimated) required for completion of existing project	545,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	175,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N N 9.)

10. *Muskegon Harbor, Michigan.*—The first improvement at this place was made at local expense by constructing slab piers and revetments so as to afford entrance from Lake Michigan to Muskegon Lake for vessels drawing 7 feet. The work was taken in hand by the Government in 1867, old piers were remodeled and extended across the bar at entrance, channel dredged, and a through depth of 12 feet obtained. Thereafter the piers were prolonged as necessitated by the steady lakeward progress of the shore line and sand deposits in advance of it, and a fair 12-foot channel thereby maintained, but the clear way between the piers was only 180 feet, making entrance dangerous in stormy weather. After 1882 this difficulty was remedied by building extensions of the north pier on a line 300 feet from the south pier and connecting the old and new lines by an oblique wing of crib work 330 feet long. In 1892 the project of improvement was amplified and defined with a view to securing and maintaining a navigable depth of 15 feet.

Its estimated cost was $260,000, which was increased in the last annual report by authority of the Chief of Engineers by an amount of $17,600.

Prior to the adoption of this modified project operations had been carried on under appropriations made from time to time in such sums as were called for to meet immediate necessities, but without defined estimates of ultimate cost. The expenditures for the work so done amounted to $262,914.18.

The total expenditure to June 30, 1899, was $462,924.43, at which date the north pier and revetment had a length of 2,579 feet and the south pier 1,485 feet, and the maximum available depth at shoalest part of the channel was 14.5 feet. Operations during the year have included dredging for the maintenance of the prescribed depth of 15 feet and extensive repairs to an aggregate length of 694 feet of revetment work. As the result of the dredging a practicable through channel of not less than 15.5 feet depth was made available for the remainder of the season of navigation after July 29, 1899. On June 30, 1900, dredging operations were in progress for again restoring the required channel depths, which had been reduced during the winter months to a maximum available depth of 13.5 feet. A contract is in force and operations were in progress at the close of the year for extending the north pier 200 feet and the south pier 100 feet. The present approved project provides for further extensions of 350 feet to the north pier and 200 feet to the south pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	2,683		1894	1,423	793,184
1889	4,626	884,869	1895	887	441,289
1890	3,786	649,540	1896	981	562,757
1891	2,886	704,046	1897	1,244	725,514
1892	4,174	740,021	1898	1,503	1,165,802
1893	2,482	834,049	1899	1,545	1,234,193

Maximum draft, 15 feet.

July 1, 1899, balance unexpended		$61,075.57
June 30, 1900, amount expended during fiscal year		16,544.27
July 1, 1900, balance unexpended		44,531.30
July 1, 1900, outstanding liabilities	$287.26	
July 1, 1900, amount covered by uncompleted contracts	39,398.36	
		39,685.62
July 1, 1900, balance available		4,845.68

Amount (estimated) required for completion of existing project	72,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	55,200.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 10.)

11. White Lake Harbor, Michigan.—The improvement at this point contemplates the creation and maintenance of a channel 200 feet wide and 12 feet deep between revetments and piers extending to deep water in Lake Michigan, thereby providing easy entrance to White Lake. Before improvement the two lakes were connected by a narrow and winding stream with a navigable capacity of only 5 feet. The estimated cost of the improvement was originally $170,530.80, subsequently increased by additional projects of 1873, 1884, and 1892 to $337,550.

The total expenditure to June 30, 1899, was $280,920.53, and the harbor works then comprised a north pier 1,515 feet long, projecting into Lake Michigan 360 feet beyond its shore line, and a south pier 1,854 feet long, projecting 700 feet beyond the shore line. The available channel depth between piers was 10 feet. Operations during the year have included dredging for restoring the required depths of the channel and thorough repairs to a length of 571 feet of the south pier. The dredging resulted in making available a channel of 12.5 feet depth for the remainder of the season of navigation of 1899 after August 3. On June 30, 1900, a narrow and crooked channel of a depth of 12 feet existed, but the straight course out had been again obstructed by the annual growth of the shoal at the end of the north pier. At the close of the fiscal year work was in progress under a contract for extending the north pier 200 feet and the south pier 100 feet. The approved project contemplates additional extensions of 50 feet to the north pier and 100 feet to the south pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	1,408	147,142	1894	195	18,115
1889	782	(*a*)	1895	281	34,574
1890	579	62,276	1896	245	27,962
1891	405	47,135	1897	247	33,409
1892	392	58,950	1898	175	16,415
1893	260	1,052,026	1899	(*a*)	(*a*)

a Not stated.

Maximum draft, 11 feet.

July 1, 1899, balance unexpended		$43,629.47
June 30, 1900, amount expended during fiscal year		12,297.24
July 1, 1900, balance unexpended		31,332.23
July 1, 1900, outstanding liabilities	$59.70	
July 1, 1900, amount covered by uncompleted contracts	27,747.56	
		27,807.26
July 1, 1900, balance available		3,524.97

Amount (estimated) required for completion of existing project	29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	27,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 11.)

12. *Pentwater Harbor, Michigan.*—Originally an unnavigable connection existed between Lake Michigan and Pentwater Lake, which had been improved by local interests so as to afford a narrow 4-foot channel at the time the Government improvement was commenced in 1867. The project of improvement then adopted and followed without modification until the present time aimed to increase the channel depth to 12 feet and maintain it between revetments and piers extending into Lake Michigan. Its estimated cost was $327,713.40.

The total expenditure to June 30, 1899, was $248,427.77, and the harbor work then comprised a north pier and revetment 2,226 feet long projecting into Lake Michigan 610 feet beyond the shore line, and a south pier and revetment 1,847 feet long projecting 621 feet beyond the shore line. The available depth in the channel at that date was 11 feet. Dredging for the maintenance of the prescribed depths was done between July 31 and August 18, and repeated between June 11 and 16. At each time a through channel was made available for vessels of 12 feet draft and this depth existed at the close of the year. Further operations during the year comprised repairs to an aggregate length of 1,819 feet of the piers.

The approved project contemplates an extension of 200 feet to the south pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	300	45,000	1894	60	(a)
1890	27	2,559	1895	500	(a)
1891	1,140	71,260	1898	1,208	108,253
1893	116	(a)	1899	(a)	(a)

a Not stated.

Maximum draft, 11 feet.

July 1, 1899, balance unexpended		$25,392.23
June 30, 1900, amount expended during fiscal year		23,698.46
July 1, 1900, balance unexpended		1,693.77
July 1, 1900, outstanding liabilities	$30.00	
July 1, 1900, amount covered by uncompleted contracts	199.40	
		229.40
July 1, 1900, balance available		1,464.37
Amount (estimated) required for completion of existing project		53,893.40
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and formaintenance, in addition to the balance available July 1, 1900		21,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 12.)

13. Ludington Harbor, Michigan.—Before the Government undertook any work for improving this harbor, local enterprise had made a narrow 7-foot channel from Lake Michigan to Pere Marquette Lake, and maintained it for several years. The Government work was commenced in 1867, with the purpose of enlarging the channel to a width of 200 feet and depth of 12 feet, and protecting it by piers projecting into Lake Michigan. The estimated cost was $270,682. The improvement was duly made, and subsequently maintained by periodical dredging and pier extensions. In 1890 the scope of the design was enlarged, and 18 feet was fixed upon as the depth to be obtained, thereby necessitating extensions of 500 and 700 feet to the north and south piers, respectively. It was further designed that these extensions should be so made as to increase the width at entrance to 250 feet.

The river and harbor act of March 3, 1899, adopted a still further modification of the project, which provides for 700 feet extension to the north pier and 300 feet extension to the south pier, dredging, and repairs.

The whole amount expended to June 30, 1899, was $384,606.55, resulting in the construction and maintenance of a north pier 1,659 feet long and a south pier 2,684 feet long, and in an extensive amount of periodical dredging in the channel way between them. The maximum depth at the shoalest part of the channel June 30, 1899, was not less than 19 feet, but the channel was narrowed at the entrance, due to an encroaching shoal from the north. Dredging for the maintenance of the channel was done in August, was resumed in June, and was in progress at the close of the year. A contract is in force for the repairs of an aggregate length of 707 feet of the piers.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	1,778	277,074	1894	1,466	426,599
1889	1,759	....	1895	1,556	594,124
1890	2,270	461,997	1896	1,996	952,469
1891	2,420	610,057	1897	2,063	2,944,425
1892	1,969	538,568	1898	2,493	2,014,019
1893	979	211,438	1899	2,587	2,254,495

Maximum draft, 15 feet.

July 1, 1899, balance unexpended		$28,827.55
June 30, 1900, amount expended during fiscal year		3,871.47
July 1, 1900, balance unexpended		24,956.08
July 1, 1900, outstanding liabilities	$146.67	
July 1, 1900, amount covered by uncompleted contracts	16,429.68	
		16,576.35
July 1, 1900, balance available		8,379.73
Amount (estimated) required for completion of existing project		185,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		69,300.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 13.)

14. *Manistee Harbor, Michigan.*—Before the Government undertook any work at this place, local enterprise had opened an entrance to the river for vessels drawing 7 feet. Systematic work was commenced by the Government in 1867, under a project for pier construction and dredging, with a view of forming and maintaining a navigable channel 12 feet deep at the entrance to and between the piers. The project was extended in 1873 to include dredging in the river for a distance of about 1,350 feet inside the shore end of piers, and to constructing revetments along the line of channel so dredged. In 1890 the scope of operations was again extended to include dredging a channel 15 feet deep throughout the length of the Manistee River, a distance of about 8,000 feet, from Lake Michigan to Manistee Lake, and to extending the north and south piers, respectively, to the 18 and 14 foot curves in Lake Michigan, with a view to maintaining a depth of 15 feet at the entrance. The river channel was dredged through in 1891–92, and the proposed exten-

sion of the north pier was completed in 1893. The south pier has not yet been extended.

The total estimated cost of all work contemplated by the projects above referred to was $408,000, and the total expenditure applied to their construction and maintenance to June 30, 1899, $364,567.63. The total length of piers constructed was 4,105 feet, and on that date the available-channel depth was 14 feet. Dredging for the maintenance of the channel was done in August and September, 1899, and was repeated in June, 1900. As a result a practicable channel of 14 feet depth has been maintained from Lake Michigan to Manistee Lake, with depths of 15 feet or more near the harbor entrance. A contract is in force and operations are in progress for extending the south pier 100 feet, and for repairing an aggregate length of 304 feet of pier work.

The approved project contemplates an additional extension of 250 feet to the south pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	3,595	966,221	1894	3,064	956,463
1889	3,524	945,329	1895	3,054	930,645
1890	3,691	975,049	1896	2,355	643,048
1891	3,617	1,079,818	1897	2,371	666,000
1892	4,044	1,028,629	1898	1,856	528,752
1893	2,831	959,550	1899	2,313	693,662

Maximum draft, 14 feet.

July 1, 1899, balance unexpended		$30,432.37
June 30, 1900, amount expended during fiscal year		4,497.22
July 1, 1900, balance unexpended		25,935.15
July 1, 1900, outstanding liabilities	$203.67	
July 1, 1900, amount covered by uncompleted contracts	16,818.62	
		17,022.29
July 1, 1900, balance available		8,912.86

Amount (estimated) required for completion of existing project		30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$30,000.00	
For maintenance of improvement	12,000.00	
		42,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 14.)

15. Harbor of refuge at Portage Lake, Manistee County, Mich.—The great need of a harbor of refuge in this vicinity has long been recognized, and the peculiar adaptability of Portage Lake led to its selection for this purpose as far back as 1878. Congress made the first appropriation for the work in the following year, and it has been in progress since that time; but until the action of Congress in the river and harbor act of March 3, 1899, which placed the work under the continuing-contract system, the provisions have been so inadequate that it has been impossible to attain the object in view.

The total amount expended to June 30, 1899, was $147,409.88, with the result that 2,812 feet of piers and revetments had been built and maintained, and a channel way between the piers had been maintained from year to year by dredging. The maximum available depth at the shoalest part of the channel on June 30, 1899, was 10 feet.

Dredging for maintaining a practicable channel depth of 12 feet was done in August and September, and was again in progress at the end of the fiscal year. Funds are available for the completion of the pier extensions required for maintaining a channel depth of 18 feet when created, the total amount authorized by the act of March 3, 1899, having been appropriated. But provision remains to be made for the dredging necessary to produce the required depth of 18 feet, and until this is done the harbor will not be available for the purposes for which it was designed. Contract has been entered into for the prescribed extensions of the piers, and operations under it are now in progress.

Entrances and clearances can not be obtained.

Maximum draft, 11 feet.

July 1, 1899, balance unexpended		$78,090.12
Amount appropriated by sundry civil act approved June 6, 1900		85,000.00
		163,090.12
June 30, 1900, amount expended during fiscal year		5,792.39
July 1, 1900, balance unexpended		157,297.73
July 1, 1900, outstanding liabilities	$274.96	
Julv 1, 1900, amount covered by uncompleted contracts	147,348.92	
		147,623.88
July 1, 1900, balance available		9,673.85
Amount (estimated) required for completion of existing project		33,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix N N 15.)

16. *Frankfort Harbor, Michigan.*—Before any work was done by the Government, Lake Aux Becs Scies (Frankfort) could be entered from Lake Michigan by a narrow and uncertain channel 3 or 4 feet deep. The project adopted on commencing improvement in 1867 was to dredge a new connecting channel 12 feet deep and 200 feet wide, and to protect its sides by pile revetments and its entrance by crib piers extending 672 feet into Lake Michigan on the north side and 832 feet on the south side. The estimated cost was $146,400. This project was afterwards modified from time to time to provide for repairs, dredging, and necessary pier extension, until, in the project as adopted in 1892, the original estimate had been increased to $325,659.85, as the total estimated cost of original construction, maintenance and repairs, and new work. This estimate was further increased in the annual report of 1899, by authority of the Chief of Engineers, by an amount of $14,000. The river and harbor act of June 3, 1896, provided for a navigable channel 18 feet deep.

The total expenditure to June 30, 1899, was $341,571,69, and the north pier then had a length of 1,499 feet and the south pier 1,537 feet, 400 of which was built by the Toledo and Ann Arbor Railway Company, without expense to the Government, in order to expedite work under the new project. The available channel depth on the last-named date was 16.5 feet.

An extension of 600 feet to the north pier, supplementing that made to the south pier by the railway company, is essential for completing the improvement so as to provide and maintain the navigable depth of 18 feet called for by the river and harbor act of June 3, 1896, and urgently needed for the commerce of this port. Funds are available for the construction of 200 feet of this extension.

The main work accomplished during the year was the annual dredging that is necessary to remove the shoal that habitually forms in the winter outside the entrance between the piers, due to the insufficient length of the north pier. The result of the dredging was the restoration for the time being of an available channel of 18 feet depth. A contract is in force for the 200-foot extension of the north pier, for which funds are available, and for thorough repairs of 301 feet of the piers. Operations were begun on May 23, and were in progress at the end of the year, but little had been done at that time.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	1,342	216,376	1894	1,101	337,728
1889	(*a*)	(*a*)	1895	1,182	412,951
1890	443	57,140	1896	1,374	509,277
1891	1,541	258,908	1897	1,714	706,546
1892	910	167,777	1898	1,681	793,896
1893	988	278,709	1899	1,790	1,405,955

a Not stated.

Maximum draft, 14 feet.

July 1, 1899, balance unexpended		$36,366.66
June 30, 1900, amount expended during fiscal year		4,133.64
July 1, 1900, balance unexpended		32,233.02
July 1, 1900, outstanding liabilities	$100.00	
July 1, 1900, amount covered by uncompleted contracts	25,831.65	
		25,931.65
July 1, 1900, balance available		6,301.37
Amount (estimated) required for completion of existing project		44,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$44,000.00	
For maintenance of improvement	10,500.00	
		54,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 16.)

17. Charlevoix Harbor, Michigan.—The improvements at this place are designed to furnish access to Round and Pine lakes, situated in the northern part of the peninsula between Grand and Little Traverse bays. The original outlet from these lakes to Lake Michigan was a narrow stream through which boats drawing only 2 or 3 feet could pass, but local enterprise improved these conditions by dredging and temporary pier construction so as to permit the passage of vessels drawing 6 feet. Work was then commenced by the Government with an appropriation of $10,000, made in the river and harbor act of August 14, 1876, the project providing for dredging a straight channel 100 feet wide to a depth of 12 feet through Pine River to Round Lake, and protecting its sides by pile revetments and its entrance by crib piers 150 feet apart, extending to 12 feet of water in Lake Michigan. This project was extended in 1882 to provide a revetted channel 12 feet deep from Round to Pine Lake, and with this modification the estimated cost of the whole improvement was $186,000.

The structures built since the improvement was commenced comprise 2,484 linear feet of pile revetment and 1,271 feet of crib piers in the lower channel from Lake Michigan to Round Lake, and 705 feet of pile revetments in the upper channel which forms the connection between Round and Pine lakes, making the total length of piers and revetments 4,460 feet. All this work, together with a large amount of dredging, was completed by 1890, and everything done from that time to the beginning of the last fiscal year was for maintaining the improvement by miscellaneous repairs of piers and revetments and dredging.

The total expenditure for original improvements and their maintenance to June 30, 1899, was $134,581.10. On that date the available channel depth was 14 feet in the lower channel, from Lake Michigan to Round Lake, and 13 feet in the upper channel, from Round to Pine Lake. As a result of dredging done in July a practicable channel of a depth of not less than 15 feet from Lake Michigan to Round Lake, and of not less than 13 feet between Round and Pine Lake, was temporarily restored. These depths were still available on June 30, 1900. Emergency repairs to a length of 168 feet of the south revetment, which was in danger of collapsing due to the pressure of a yielding bank behind it, were made during the winter and spring. Operations were commenced on June 16, and were in progress at the end of the year, under a contract for repairing a length of 402 feet of the south revetment.

The approved project includes an extension of 200 feet to the south pier.

Entrances and clearances.

Calendar year.	Number.	Tonnage.	Calendar year.	Number.	Tonnage.
1888	526	92,306	1894	1,701	338,015
1889	473	....	1895	528	92,387
1890	532	75,224	1896	420	75,263
1891	534	79,613	1897	545	110,474
1892	537	79,966	1898	566	106,797
1893	820	144,976	1899	675	144,400

Maximum draft, 13.5 feet.

July 1, 1899, balance unexpended		$20,918.90
June 30, 1900, amount expended during fiscal year		8,591.46
July 1, 1900, balance unexpended		12,327.44
July 1, 1900, outstanding liabilities	$76.00	
July 1, 1900, amount covered by uncompleted contracts	6,606.25	
		6,682.25
July 1, 1900, balance available		5,645.19
Amount (estimated) required for completion of existing project		30,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		23,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix N N 17.)

18. Petoskey Harbor, Michigan.—Petoskey is so situated on the southeast shore of Little Traverse Bay that its water front is wholly exposed to winds coming from between west and northwest, and when high gales, with a sweep of more than 100 miles across Lake Michigan, blow from that quarter it is hazardous to make a landing in the immediate vicinity. To remedy this condition Congress, by the river and harbor act of August 18, 1894, authorized the construction of breakwaters designed to cover the landing pier and provide a small sheltered area adjoining them. The estimated cost of the project was $170,000.

The total expenditure to June 30, 1899, was $51,829.21, resulting in the construction and maintenance of 801 linear feet of breakwater. No work was done during the past fiscal year; the expenditures during the year were for payment of a proportional part of expenses of repair and alteration of the survey and inspection boat *Williams*, belonging to this district. Bids will be opened July 25 for minor repairs to the harbor structures.

The project does not contemplate an increase in the available depth at this harbor, which is sufficient for the present needs of commerce.

Available funds are not sufficient for the extension of 600 feet to the north breakwater, as required by the approved project, and an estimate is submitted to supply the deficiency.

Entrances and clearances.

Calendar year.	Number.	Tonnage.
1893	1,338	8,000
1894	4,160	20,000
1895	4,360	28,000
1896	3,156	24,000
1897	4,362	91,600
1898	4,704	76,000
1899	(a)	(a)

a Not stated.

Maximum draft, 11 feet.

July 1, 1899, balance unexpended	$21,170.79
June 30, 1900, amount expended during fiscal year	200.00
July 1, 1900, balance unexpended	20,970.79
Amount (estimated) required for completion of existing project	97,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N N 18.)

19. Removing sunken vessels or craft obstructing or endangering navigation—(*a*) *Wreck of steamer Horace A. Tuttle.*—A portion of this wreck, which obstructed the entrance to Michigan City Harbor, had been removed at the beginning of the fiscal year. The removal of the remainder was completed September 12, 1899. The total expense of removing this wreck was $6,432.28.

(*b*) *Wreck of steamer City of Duluth.*—Operations in progress at the beginning of the year under a contract for the removal of the wreck of the *City of Duluth* from St. Joseph Harbor, Michigan, were completed on August 26, at which date the obstruction was entirely removed. The total expense of removing this wreck was $2,253.06.

The total expenditure during the year for the removal of wrecks was $4,690.

(See Appendix N N 19.)

EXAMINATIONS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations of the following localities, required by the river and harbor act of March 3, 1899, were made by the local officer, Capt. Chester Harding, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. J. W. Barlow, Corps of Engineers:

1. *Preliminary examination of Muskegon River, Michigan, from the head of Muskegon Lake to Newaygo.*—Captain Harding submitted report August 16, 1899. In his opinion, concurred in by the division engineer, and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 56, Fifty-sixth Congress, first session. (See also Appendix N N 20.)

2. *Preliminary examination of channel from Lake Michigan to Stony Lake, Oceana County, Mich.*—Captain Harding submitted report August 29, 1899. In his opinion, concurred in by the division engineer, and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 139, Fifty-sixth Congress, first session. (See also Appendix N N 21.)

3. *Preliminary examination at Arcadia, Mich.*—Captain Harding submitted report August 22, 1899. In his opinion, concurred in by the division engineer, and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 132, Fifty-sixth Congress, first session. (See also Appendix N N 22.)

EXAMINATION OF MUSKEGON HARBOR, MICHIGAN, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Muskegon Harbor, Michigan, with a view to obtaining a channel of the depth of 20 feet and uniform width of 300 feet from the exterior to the interior lake; the plan to provide for sheet piling, to prevent erosion along the banks not protected by cribs*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF RIVERS AND HARBORS ON THE EASTERN COAST OF MICHIGAN AND OF WATERS CONNECTING THE GREAT LAKES.

This district was in the charge of Lieut. Col. G. J. Lydecker, Corps of Engineers, having under his immediate orders Lieut. Spencer Cosby, Corps of Engineers, from October 4 to November 2, 1899.

1. *Ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.*—This project was adopted by the river and harbor act of July 13, 1892, when the available depth for navigation through these waters was about 16 feet. Its object is to increase this depth to 20 feet. The estimated cost of the improvement was $3,340,000.

Operations were commenced in the spring of 1893, and by June 30, 1898, channels of the prescribed depth had been completed, with widths varying from 300 to 2,400 feet at all places specified in the original project, and through several other shoals where work was subsequently found to be necessary in order to accomplish the object in view. The total expenditure to June 30, 1899, was $2,751,554.86.

Operations were in progress during the past fiscal year at Round Island Shoals, St. Marys River, by which the dredged channels through these shoals were made wider and deeper. The work was commenced in September, 1897, and completed in November, 1899; the total amount of excavation was 448,313 cubic yards, bank measure. By this work the channels through these shoals were increased in width from 300 feet to 800 feet, and in depth from 21 to 23 feet. Commerce is very much benefited by this improvement, the locality being open to high seas rolling in from Lake Superior, and subject to dense fogs during the spring and fall months.

In the lower Detroit River work was continued along the Grosse Isle lower range until October 5, 1899. This work had been commenced in April, 1898. The total excavation was 84,045 cubic yards, and the improved channel thereby obtained now has a clear depth of 21 feet, with a uniform width of 300 feet; the depth before improvement was 15½ feet.

Minor items of work were done at other places, such as removing small local shoals, or picking up scattering bowlders; many surveys and examinations by sweeping raft were made in connection with works of improvement in progress, or to obtain necessary data for future work.

Congress has already appropriated the full amount of the estimate, and funds in hand will suffice for completing work contemplated by the original project. For this reason no additional estimate is now submitted.

The amount of freight carried through the St. Marys River sections of this channel during the navigable season of 1899 was 27,520,205 tons, valued at $281,364,750. Reliable statistics of traffic through the Detroit River are not obtainable, but such as we have been able to procure indicate that about 40,000,000 tons of freight passed during that season.

July 1, 1899, balance unexpended	$591,223.20
June 30, 1900, amount expended during fiscal year	174,998.79
July 1, 1900, balance unexpended	416,224.41
July 1, 1900, outstanding liabilities	2,124.68
July 1, 1900, balance available	414,099.73

(See Appendix O O 1.)

2. *St. Marys River at the falls, Michigan.*—When the present project of improvement was adopted in 1886, the maximum draft which vessels could carry through the canal and locks at Sault Ste. Marie, Mich., was 16 feet, the old State Lock of 1855 having 11½ feet of water over miter sills, and the United States Lock of 1881, now known as the Weitzel Lock, 16 feet. Work under the new project was commenced in 1887, the essential purpose being to construct a new lock on the site of the old State locks, with a depth of 21 feet over miter sills, and to enlarge and deepen the canal and its approaches correspondingly, the estimated cost of the proposed improvement being $4,738,865.

The amount expended to June 30, 1899, was $3,802,986.17. The principal features of the projected improvement had been completed in 1896, the new lock, now known as the Poe Lock, having been opened to navigation August 3, of that year, and the canal deepened to a depth of 25 feet. Work since that time has been limited to further improvement relating to the canal approaches, including a partial reconstruction and extension of the canal piers.

Operations during the past fiscal year included the construction of 416 linear feet of crib work for extending the northeast pier of approach to the Poe Lock, and like work was still in progress at the close of the year with the purpose of carrying the extension 250 feet farther. The object of this extension is to provide adequate and convenient berthing space for up-bound vessels while they are awaiting turn and opportunity to enter the lock. Other work, of minor importance, included the removal of several bowlders that had been dragged by towlines of vessels into the channel of approach to the Weitzel Lock, dredging shoals that had formed in front of the Fort Brady pier, removal of all spoil banks from the upper canal piers, grading and seeding the canal grounds adjoining the south pier, setting out 560 shade trees in the canal grounds, constructing 2,600 linear feet of picket fence in dividing line between grounds and city streets, and laying 1,334 square yards of concrete walks in approaches from streets to locks. A great deal of work was done in the way of surveys and examinations by sweeping raft, with a view to ascertaining the navigable condition of improved channels in the river, and locating obstructions preparatory to their removal.

No additional estimate is submitted, as the balance of the previous appropriations will suffice for all work required to complete improvements thus far authorized.

The commerce passing the falls of St. Marys River during the navigation season of 1899, a period of 231 days, comprised 25,255,810 tons of freight, valued at $281,364,750; the number of passengers reported on vessels for the same period was 49,082.

July 1, 1899, balance unexpended	$960,918.39
June 30, 1900, amount expended during fiscal year	[1] 130,027.64
July 1, 1900, balance unexpended	830,890.75
July 1, 1900, outstanding liabilities	2,957.43
July 1, 1900, balance available	827,933.32

(See Appendix O O 2.)

3. *Operating and care of St. Marys Falls Canal, Michigan.*—The canal was open to navigation 244 days, the closed season being from December 18, 1899, to April 19, 1900. A total of 17,524 vessels, aggregating 20,807,873 registered tons, and carrying 24,554,559 tons of freight and 34,976 passengers, passed through the locks in 9,033 lockages. The Canadian Canal at Sault Ste. Marie, Ontario, passed 3,554 vessels in 2,473 lockages, carrying 2,965,646 tons of freight and 16,074 passengers, making the combined traffic through the two canals 27,520,205 tons of freight and 51,050 passengers; this is an increase during the year of 6,198,267 tons and 5,786 passengers, or 29 and 13 per cent, respectively.

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[1] This includes $53,388.74 paid by Treasury Department, as follows: To Navy Department, in part payment of Str. *Enquirer*, $5,000; to Collins & Farwell, in settlement of judgment, Court of Claims, $48,388.74.

The principal items of freight carried were: Iron ore, 16,885,832 tons; coal, 4,638,994 tons; flour, 7,368,680 barrels; wheat, 63,844,036 bushels; other grain, 22,901,213 bushels, and lumber, 1,034,271 feet B.M.

Other statistics in relation to this traffic and commerce are summarized in the following statements.

Summary of traffic through St. Marys Falls Canal, Michigan, for fiscal year ending June 30, 1900.

Number of vessels through Weitzel Lock	7,759
Number of vessels through Poe Lock	9,765
Number of lockages through Weitzel Lock	4,516
Number of lockages through Poe Lock	4,517
Total registered tonnage	20,807,873
Total freight tonnage	24,554,559
Total time during which locks were operated	4,229 hrs. 31 min.
Average time occupied in making a lockage	28 min. 6 secs.
Total time spent by vessels in passing locks	9,888 hrs. 28 min.
Average time spent by vessels in passing locks	23 min. 51 sec.
Cost per lockage	$8.79
Cost per passage	$4.53
Cost per registered ton	3.82 mills
Cost per freight ton	3.23 mills

The Weitzel Lock was open to navigation 227 days, from July 1 to December 7, 1899, and from April 25 to June 30, 1900.

The time for the Poe Lock was 244 days, July 1 to December 18, 1899, and from April 19 to June 30, 1900.

Summary of St. Marys River commerce via American and Canadian canals during the season of 1899, viz, from April 26, 1899, to December 20, 1899, a period of seven months and twenty-five days.

Total mile-tons		20,891,944,628
Total freight carried	tons..	25,255,810
Total valuation placed on freight carried		$281,364,756.00
Average value per ton of freight carried		$11.14
Total amount paid for freight transportation		$21,959,707.25
Average distance freight was carried	miles..	827.2
Cost per mile-ton	mills..	1.05
Average cost per ton for freight transportation	cents..	87
Total number of registered vessels using canals		832
Total number of passages by unregistered vessels carrying freight		366
Time American Canal was in service	days..	231
Time Canadian Canal was in service	do...	239
Total valuation placed on registered vessels		$68,370,120
Total number of passengers transported		49,082
Total freight carried by—		
Registered vessels	tons..	25,224,524
Unregistered vessels	do...	31,286

This service is provided for from the permanent-indefinite appropriation for operating and care of canals and other works of navigation under section 4 of the river and harbor act of July 5, 1884; the total expenditure on this account from 1881, when the Weitzel Lock was first put in service, to June 30, 1900, amounts to $893,298.21, of which $79,293.26 related to operations during the past fiscal year as follows: For pay rolls, $60,201.72; for repairs, $7,667.03; for general supplies, $4,613.72; for electric lighting, $2,723.92; and for office expenses and general contingencies, $4,086.87. The growth of freight traffic during the same period is shown by the following tabular statement.

Freight traffic.

	Tons.		Tons.
1881	1,567,741	1891	8,888,759
1882	2,029,521	1892	11,214,333
1883	2,267,105	1893	10,796,572
1884	2,874,557	1894	13,195,860
1885	3,256,628	1895	15,062,580
1886	4,527,759	1896	16,239,061
1887	5,494,649	1897	18,982,755
1888	6,411,423	1898	21,234,664
1889	7,516,022	1899	25,255,810
1890	9,041,213		

(See Appendix O O 3.)

4. Hay Lake Channel, St. Marys River, Michigan.—On account of rapids and shoals that intervened between the navigable channel of the river and the lake, at its head and foot, this channel was not navigable for commercial purposes before improvement. The original project of improvement of October 27, 1882, contemplated the excavation of channels 17 feet deep and 300 feet wide through all obstructed portions of the Hay Lake route, but this project was modified in 1886 to provide a depth of 20 feet, the total estimated cost being $2,659,115. The work of improvement was commenced in 1883, and the route opened to commerce June 7, 1894, though full width and depth of channel had not then been obtained at all points; but since then several shoals in the deep-water section of the lake have been removed, and the dredged channels have been widened at angles and other critical points.

The amount expended to June 30, 1899, was $2,112,333.49, and the improvement as it stood at that date comprised 10 miles of channel dredged to a depth of 20 or 21 feet, in 6 miles of which the width was 300 feet, and in the remaining 4 from 450 to 1,100 feet. The new channel is 11 miles shorter than the old one via Lake George; it can be navigated with reasonable safety at night, which could not be done by the old route, and it is available for vessels drawing 5 feet more water than could be safely carried through the latter.

Operations during the past fiscal year were applied to completing the work of deepening the rock cut in a part of the Middle Neebish section of the channel, and to rebuilding weak parts of the adjoining dike. The result of the work of deepening was to give an increased depth of 3 feet through that part of the Neebish channel; the purpose of work done on the dike was to secure it against further wear, or possible destruction, and this was nearly accomplished at the close of the year.

The whole commerce of the St. Marys River passes through this channel, except small river steamers engaged in local traffic and rafts of logs which continue to be taken via the old channel as a measure of safety to general commerce. The following tabular statement indicates the extent and growth of this commerce from the year in which this route was opened to travel:

Season of navigation.	Freight.	Valuation.	Passengers.
1894	13,195,860	$143,114,502	27,236
1895	15,062,580	159,575,129	31,656
1896	16,239,061	195,146,842	37,066
1897	18,982,755	218,235,927	40,213
1898	21,234,664	233,069,739	43,426
1899	25,255,810	281,364,750	51,050

The river and harbor act of March 3, 1899, provided for further work, as follows:

> Improving Hay Lake Channel, Saint Marys River: Continuing improvement, one hundred thousand dollars: *Provided*, That for the purpose of more rapidly prosecuting the project of improvement as heretofore adopted and entered upon, in addition to expending the balance on hand, a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary for such purpose, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate three hundred and ninety-four thousand one hundred and fifteen dollars, exclusive of the amount herein and heretofore appropriated: *Provided further*, That the Secretary of War shall cause to be made, and reported as early as practicable, a survey of the connecting waters between Lakes Superior and Huron, including Hay Lake Channel, with a plan and estimate of the cost of such improvement as will secure a safe and convenient channel twenty-one feet deep between said lakes, the expense of which shall be paid from the said appropriation for improving Hay Lake Channel.

The surveys called for by the foregoing were duly made, and a report on this subject will be submitted to Congress at its session in December next. In the meantime no action was taken respecting the continuing contracts authorized above, because the work should be made to conform with the more comprehensive scheme of improvement contemplated by the above-quoted provision of the last river and harbor act. It was therefore determined to defer action until the related surveys and estimates were completed, but this has now been accomplished and the contracts referred to will be made at an early date. It is believed that funds already appropriated will suffice for work that may be done under these contracts to June 30, 1902, and for this reason no additional appropriation is recommended at present.

July 1, 1899, balance unexpended	$152,808.98
Amount appropriated by sundry civil act approved June 6, 1900	250,000.00
	402,808.98
June 30, 1900, amount expended during fiscal year	52,808.98
July 1, 1900, balance unexpended	350,000.00
July 1, 1900, outstanding liabilities	18,178.05
July 1, 1900, balance available	331,821.95

(See Appendix O O 4.)

5. *Cheboygan Harbor, Michigan.*—The present harbor is the result of improvements made at the mouth of Cheboygan Harbor since 1871, when the available depth of water was only 6 feet. The project called for a channel 200 feet wide and 14 feet deep, and the estimated cost of the whole work was $395,335. The project was modified in 1880 to increase the navigable depth to 15 feet, and in 1896 to make it 18 feet, and such depth now exists from deep water in the Straits of Mackinac to a point about 2,000 feet below the upper limits of the harbor. A 40-foot square crib was built in 1881 to mark the entrance to the channel, and a light-house was subsequently placed on it by the United States Light-House Establishment.

The total expenditure to June 30, 1899, was $148,509.49, and the available channel depth at that date was 14½ feet.

During the past fiscal year dredging was in progress from August 14 to December 4, 1899, and from April 18 to May 3, 1900, the result of which was to increase the navigable depth of channel to 18 feet for about three-fourths of its total length over its full width of 200 feet. The total excavation amounted to 106,015 cubic yards.

While this work was in progress the entire harbor was resurveyed in accordance with the requirements of the river and harbor act of March 3, 1899; and the report thereon, which was transmitted to Congress April 25, 1900, is printed in House Doc. No. 636, Fifty-sixth Congress, first session; it is also herewith as Appendix O O 20. As a result of the survey above referred to it is found that $15,500 will be required to complete the channel up to the State Road Bridge to the depth of 18 feet, called for by the present approved project, and the estimate submitted below is for this purpose. It should be observed in this connection that the character of material to be dredged in the section of channel that remains to be improved will cause the unit price for excavation to be considerably higher than that at which the work thus far done was accomplished.

The following statement indicates the commerce of this harbor during the past seven calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	940	441,087	1897	1,216	340,332
1894	1,033	303,900	1898	1,336	422,741
1895	1,249	326,930	1899	1,368	415,613
1896	1,040	525,373			

July 1, 1899, balance unexpended	$19,490.51
June 30, 1900, amount expended during fiscal year	16,771.37
July 1, 1900, balance unexpended	2,719.14
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	13,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O O 5.)

6. *Alpena Harbor* (*Thunder Bay River*), *Michigan.*—The city of Alpena occupies both banks of Thunder Bay River at its mouth, and the harbor has been made by dredging the river for a distance of about a mile upstream, and through the bar at the mouth to the 16-foot contour in Thunder Bay. The improvement was formerly carried on by the Government, under separate appropriations for Thunder Bay Harbor and Thunder Bay River.

The original depth at entrance to the river was only 7 feet, but local enterprise increased it to 12 feet. The work of improvement by the Government was commenced in 1876, and has provided a wider channel and increased the depth to 13, 14, and 16 feet under successive projects, the total of the three separate estimates being $55,851. The last project was completed in 1893, and nothing was done from that time until the summer of 1899.

The total amount expended to June 30, 1899, was $42,478.18.

At the beginning of the past fiscal year the channel had shoaled to such an extent as to limit the safe draft of vessels to scant 13 feet, and a contract was thereupon entered into for redredging it. Work under the contract was commenced September 5, and duly completed November 8, 1899, the total amount of dredging done being 42,497 cubic yards. The result of the work was to give the channel a least depth of 16 feet, and enable vessels to pass through the harbor drawing 3 feet more than before the work was done. Previous experience indicates that the improvement will have a fair degree of permanence, and that little or no expenditure will be required for its maintenance in the near future.

The following statement indicates the commerce of this harbor during the past seven calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	940	360,588	1897	1,245	353,962
1894	1,033	465,991	1898	980	270,743
1895	1,249	305,160	1899	802	221,888
1896	1,040	349,754			

July 1, 1899, balance unexpended	$9,021.82
June 30, 1900, amount expended during fiscal year	6,335.89
July 1, 1900, balance unexpended	2.685.93

(See Appendix O O 6.)

7. *Saginaw River, Michigan.*—Before improvement the navigable capacity of this stream was limited by the bar at its mouth, where a channel depth of only 8 feet was available, and by many shoal stretches in the river between there and the city of Saginaw over which still less depth was to be found. Its improvement was commenced in 1867 by dredging a straight cut through the bar at the mouth to a depth of 13 feet. In subsequent years the scope of operations was gradually extended to various shoals higher up, but subject to no general project until 1882, when a comprehensive and connected scheme of improvement covering the entire river was adopted. It called for a navigable channel 14 feet deep and 200 feet wide from Saginaw Bay to the upper limits of Bay City, about 8 miles above the point of beginning, and thence to the head of navigation, some 16 miles farther up, a channel of the same width but only 12 feet deep. The estimated cost of this project was $446,000, which, added to the estimated cost of the several preceding projects ($294,378), gives $740,378 as the estimate of cost for the whole improvement. These estimates concerned the question of original cost only and took no note of maintenance, which, in a stream of this character, is a matter of great and constant expense, and in the absence of appropriations specifically applicable thereto must be an annual tax of no small magnitude on the successive appropriations for construction. The sum total of appropriations that will have to be made before the work can be completed must therefore largely exceed the original estimates for construction only.

The total expenditure to June 30, 1899, was $710,492.60, and the result has only been to obtain a narrow through channel, which has little permanence, and almost constant dredging is needed to maintain it. This has been the case especially as respects the section of river from Bay City to Saginaw and in a somewhat less degree through the bar at the river's mouth in Saginaw Bay.

At the beginning of the past fiscal year the maximum depth available over most shoal places above Bay City was only 10 feet, and the available depth through the bar at mouth 13 feet. Contracts were thereupon entered into for restoring the required depth, and work was in progress under them from August 23, 1899, until the end of the year, except during the winter months; the total amount of dredging accomplished was 188,461 cubic yards, of which 101,650 cubic yards was dredged from the channel through the bar at the mouth of the river and 86,811 cubic yards from the river shoals between Bay City and Saginaw. The bar channel was dredged to a depth of 16 feet and the river shoal to 14 feet, but the resultant commercial benefit will be only temporary, as the width of channels dredged through shoals in the river is from 80 to 100 feet only, and with that limited width the depth will diminish very rapidly.

In order to restore and maintain these channels, as required in the interests of navigation, the work of dredging should be constant until they have been excavated to a depth of 14 feet and a minimum width of 150 or 200 feet.

The narrow dredged channels between the mouth of the river and the city of Saginaw will probably have to be redredged during the current fiscal year in order to restore and maintain the required channel depth. It is proposed to apply the balance of funds now available to such dredging in whole or in part as may be necessary for this purpose.

The commerce of the river for the past seven calendar years, as compiled from the most reliable information available, is approximately indicated in the following tabular statement:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	1,290	393,487	1897	1,034	330,031
1894	226	72,702	1898	996	304,827
1895	226	72,689	1899	889	336,269
1896	189	48,752			

July 1, 1899, balance unexpended		$77,257.40
June 30, 1900, amount expended during fiscal year		30,630.63
July 1, 1900, balance unexpended		46,626.77
July 1, 1900, outstanding liabilities	$15,565.98	
July 1, 1900, amount covered by uncompleted contracts	12,312.12	
		27,878.10
July 1, 1900, balance available		18,748.67
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900		37,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O O 7.)

8. *Sebewaing River, Michigan.*—This stream discharges into the eastern part of Saginaw Bay. In 1875 the river channel was straightened, deepened to 6 feet, and the work of dredging extended to the 6-foot contour in Saginaw Bay; in 1880–81 this channel was deepened to 7 feet. The total expenditure in these operations was $15,000.

The present project of improvement was adopted by the river and harbor act of June 3, 1896, and provides for dredging the entrance channel for a length of about 15,000 feet, to a width of 100 feet and depth of 8 feet, the estimated cost being $37,000.

The above-named act appropriated $5,000 for work under the new project, but operations were not commenced, because no useful results could be accomplished by the expenditure of so small a sum; the river and harbor act of March 3, 1899, supplied the necessary additional funds, but no work was done or expenditure made up to June 30, 1899, on which date advertisement was published inviting proposals.

Contract for dredging under the approved project was approved September 13, 1899, but stormy weather prevented the arrival of the contractor's plant until September 29, and it was the middle of October before he was able to do any work. Operations were continued until the end of November, when it became necessary to place the plant in winter quarters; work was resumed May 1, 1900, and is still in progress. The amount of material excavated and deposited at designated dumping grounds to June 30, 1900, was only 10,770 cubic yards, but a great amount was cast over by the dredge in preparing suitable channels in which to operate and berth the plant. The location is a very exposed one, and operations will be very slow and troublesome. No appreciable benefit to commerce has resulted from the work thus far done.

The total estimated cost of the improvement has been appropriated, and the contract price of work is such that the money now available will suffice for completing it unless the contractor should fail to meet his contract obligation. Accordingly, no estimate for further appropriation is presented in this report.

The total amount expended to June 30, 1899, for improvement of this river was $15,000.

July 1, 1899, balance unexpended		$37,000.00
June 30, 1900, amount expended during fiscal year		1,449.63
July 1, 1900, balance unexpended		35,550.37
July 1, 1900, outstanding liabilities	$1,067.27	
July 1, 1900, amount covered by uncompleted contracts	33,276.80	
		34,344.07
July 1, 1900, balance available		1,206.30

(See Appendix O O 8.)

9. *Harbor of refuge at Sandbeach, Lake Huron, Michigan.*—The site for this harbor, selected in 1872 after careful consideration, is on the west shore of Lake Huron, 60 miles north of its outlet into the St. Clair River, and the artificial harbor built there since then is the only safe refuge on that coast from the foot of the lake to Tawas Bay, 115 miles above. The work of construction was commenced in 1873, under a project providing for three sections of breakwater made of stone-filled crib work, so located as to shelter a water area of some 650 acres, and for deepening this area by dredging where necessary. The estimated cost was $1,442,500. The sheltering breakwaters, with a total length of 8,132 feet, were completed in 1885 at a cost of about $975,000, and since that time expenditures have been applied to keeping them in repair, dredging, regulating and controlling the berthing of vessels entering the harbor for refuge, engineering supervision, and general office expenses.

The total expenditure to June 30, 1899, was $1,205,781.61.

The expenditure for the past fiscal year was applied to making some temporary repairs to superstructures of the main breakwater and to general contingencies, including custody of harbor, supervision, control of vessels, and office expenses.

The number of vessels that entered the harbor for refuge during the past fiscal year was 1,216, with a total tonnage of 687,029. The grand total of vessels that have found shelter there from 1877 to 1899, inclusive, is 27,465, the tonnage of which aggregated 9,664,107. The vessels sheltered in 1877 averaged 289 tons each and those during the year 1899, 544 tons.

During the present fiscal year it is proposed to commence to rebuild the superstructure of the main breakwater in concrete, the work to be done under the continuing-contract system, as authorized by the last river and harbor act.

July 1, 1899, balance unexpended		$150,325.44
Amount appropriated by sundry civil act approved June 6, 1900		150,000.00
		300,325.44
June 30, 1900, amount expended during fiscal year		4,240.76
July 1, 1900, balance unexpended		296,084.68
July 1, 1900, outstanding liabilities		477.00
July 1, 1900, balance available		295,607.68
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$50,000.00	
For maintenance and custody of improvement	7,500.00	
		57,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix O O 9.)

10. Mouth of Black River, Michigan.—An extensive shoal and a bar formerly existed in the St. Clair River, adjoining the mouth of the Black. The bar lay close to the American side and obstructed approach to the Port Huron docks, while the shoal, forming a "middle ground" nearly 50 acres in extent, crowded the main channel in a sharp curve close to the Canadian shore. In 1871 a project was adopted for dredging the bar and middle ground to a uniform depth of 15 feet; work was commenced in 1872 and completed in 1878. The whole area was redredged between 1889 and 1892, and again in 1897, to a depth of 16 feet. The total expenditure to June 30, 1899, was $92,624.46.

No work was in progress during the past fiscal year, and the total expenditure of $255.41 was for general office and engineering contingencies, including a careful sounding of the area in the spring of 1900 to ascertain what work, if any, might be needed during the current season of operations. This examination showed a small amount of dredging to be desirable to improve the approach to the Port Huron docks, and it is proposed to do this work in connection with a contract that will be in force during the present season in the immediate vicinity.

This recent examination and all previous experience show that the shoal will re-form gradually, and as vessels of moderate draft habitually pass over this area instead of through the main channel followed by those of deep draft, it is very desirable that means be at hand for maintaining the improvement as the interests of this commerce require. Funds now available will suffice for that purpose during the current year, but an additional appropriation will probably be required for the year following.

July 1, 1899, balance unexpended	$5,875.54
June 30, 1900, amount expended during fiscal year (including 41 cents paid by Treasury Department, account Postal Telegraph Cable Co.)	255.41
July 1, 1900, balance unexpended	5,620.13
July 1, 1900, outstanding liabilities	34.57
July 1, 1900, balance available	5,585.56
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix O O 10.)

11. Black River at Port Huron, Mich.—The improvement of this stream was inaugurated by the river and harbor act of September 19, 1890, under a project which contemplated dredging it to a navigable depth of 16 feet from its mouth to the Grand Trunk Railway Bridge, at an estimated cost of $75,000, and the act of July 13, 1892, directed that the improvement be extended 1,400 feet farther upstream, to Washington avenue. Operations were commenced in 1891 and continued until the summer of 1893, when the required 16-foot channel had been dredged throughout the designated limits to a width varying between 160 feet near the mouth and 50 or 75 feet in the contracted river sections above. The total length of channel so dredged was 9,700 feet. Before improvement the minimum channel depth was between 8 and 10 feet for about 1 mile from the mouth of the river, but only 6 to 8 feet from there up to Washington avenue. The narrow upstream section and some shoal spots in the wider section below were redredged in 1897.

The total expenditure to June 30, 1899, was $42,217.33, and no work has been done since then.

The expenditure for the past fiscal year was applied to engineering and general office contingencies, including a thorough examination of the river in April, 1900, which showed that every evidence of the dredging done above the Grand Trunk Railway Bridge had been obliterated, the maximum available draft that could be carried over the shoalest parts of the channel being scant 9 feet, but up to that bridge a draft of a little over 12 feet could be carried safely. This confirms all previous experience and observation, showing conclusively that the narrow dredged channels in the upper limits of the improvement can have no reasonable degree of permanence.

Advertisement for proposals to redredge the channel to the depth of 16 feet, so far as available funds will permit, was published June 20, 1900, and the work will soon be in progress.

Annual dredging is necessary for maintaining this improvement, and for this reason an estimate of $8,000 is submitted below for the fiscal year ending June 30, 1902.

The following statement indicates the commerce of this river during the past seven calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	602	182,568	1897	645	98,380
1894	595	120,948	1898	216	82,410
1895	587	111,675	1899	504	110,860
1896	628	189,556			

July 1, 1899, balance unexpended	$4,782.67
June 30, 1900, amount expended during fiscal year	268.96
July 1, 1900, balance unexpended	4,513.71
July 1, 1900, outstanding liabilities	63.82
July 1, 1900, balance available	4,449.89
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O O 11.)

12. Pine River, Michigan.—This river was improved in 1875 by dredging a channel 100 feet wide, 12 feet deep, for a distance of about three-fourths of a mile from the mouth, at a cost of $5,000. This channel shoaled in time, and after an examination of the river, called for by the river and harbor act of July 13, 1892, a project for further improvement was prepared under the act of August 18, 1894, and the act of June 3, 1896, appropriated $5,000 for commencing the work. This project provides for dredging a channel 14 feet deep, extending about 5,800 feet from the mouth, the width to be 100 feet or 75 feet, according to locality; the estimated cost is $10,560. Work on the new project was commenced September 24 and continued until November 16, 1896, when operations were suspended to await further appropriation. Nothing further was done until the summer of 1899.

The total expenditure for improvements on the river to June 30, 1899, was $9,722.05. Of this total, $4,722.05 pertains to the work thus far done under the new project, by which the depth of channel was increased from 9 to 14 feet through nearly one-half of the total distance contemplated by the project.

Operations were resumed August 28, 1899, under the appropriation made by river and harbor act of March 3, 1899, and continued until October 19, when the improvement was completed as proposed, and a balance of the last appropriation, amounting to $1,913.11, is now on hand, which will suffice for all probable contingencies of supervision, maintenance, etc., for some time to come.

The commerce of this river during the past four calendar years, as derived from the best information obtainable, amounted to 2,683 freight tons for 1896, 6,820 for 1897, 107,800 for 1898, and for 1899, 822,660, the total for the four years being 939,963 freight tons.

July 1, 1899, balance unexpended	$5,837.95
June 30, 1900, amount expended during fiscal year	3,924.84
July 1, 1900, balance unexpended	1,913.11

(See Appendix O O 12.)

13. Belle River, Michigan.—This river was improved, 1880–1885, by dredging a channel 50 feet wide, 13 feet deep, to the first bridge and 12 feet deep to the second one, a total distance of 5,400 feet. The total cost was $14,000 and the principal benefit was to provide a winter harbor for vessels.

The river and harbor act of July 13, 1892, called for an examination of the river, and that of August 18, 1894, for survey and estimate of cost of its further improvement. Project for redredging the channel to a width of 75 feet and depth of 15 feet to the first and 14 feet depth to the second bridge was submitted November 30, 1895, the estimated cost being $21,500. The act of June 3, 1896, appropriated $5,000 for beginning the work, and dredging to the extent of about 40,000 cubic yards was done during the summer of 1897, thereby obtaining the required depth and width of channel for a distance of about 2,400 feet above the mouth of the river. Operations were then suspended to await further appropriation, and no further work was done until the summer of 1899.

The total expenditure for all improvements to June 30, 1899, was $18,933.75, of which $4,933.75 was applied to operations under the project now in force.

The river and harbor act of March 3, 1899, having appropriated $10,000 for completing the improvement, operations were resumed August 22, 1899, and the work was completed in accordance with the approved project October 3, 1899. The total cost of the improvement, including all contingences, was $10,300.88.

No further appropriation is required at present, the unexpended balance of those already made being sufficient to provide for all contingencies of supervision, maintenance, etc., for some considerable time to come.

The following statement indicates the commerce of this river during the past three calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.
1897	52	3,092
1898	60	23,743
1899	85	33,272

July 1, 1899, balance unexpended	$10,066.25
June 30, 1900, amount expended during fiscal year	5,367.13
July 1, 1900, balance unexpended	4,699.12

(See Appendix O O 13.)

14. St. Clair Flats Canal, Michigan.—This improvement dates back to 1866; it is a dredged cut, connecting the main channel of St. Clair River with deep water in Lake St. Clair. The dredged material was deposited so as to form dikes on each side of the cut, the channel faces of which are sustained by substantial sheet-pile revetments; the width of water way between revetments is 292 feet, depth of water 20 feet at mean stage, and length of each lateral dike 7,221 feet. Before improvement, the general depth of water over the entire area included in the canal was only 6 feet.

The total amount appropriated for this improvement from its beginning, in 1866, is $764,810, and the total expenditure to June 30, 1899, $761,750.61.

No operations were in progress or expenditure made during the past fiscal year.

No specific appropriation has been made for this work since 1890, and there is now an unexpended balance of $3,059.39, which it is proposed to apply during the ensuing fiscal year to repairing and extending the protecting pile work at the head and foot of the canal dikes.

No further estimate is submitted for work under the present approved project; but the emergency river and harbor act of June 6, 1900, called for survey and estimate, with a view to doubling the capacity of the canal, and full special report in the matter will be laid before Congress at the beginning of its next session. It is therefore sufficient to state here that the report will indicate that prompt action in the direction above indicated is all important to the safety and convenience of the vast commerce of the Great Lakes. Traffic through the canal during the navigation period of the calendar year 1899—a period of nine months only—included the passage of about 40,000,000 tons of freight, but we have no data to estimate, even approximately, the extent of passenger traffic.

July 1, 1899, balance unexpended	$3,059.39
July 1, 1900, balance unexpended	3,059.39

(See Appendix O O 14.)

15. Operating and care of St. Clair Flats Canal, Michigan.—This service is provided for by the permanent-indefinite appropriation for operating and care of canals and other works of navigation, under the provisions of section 4 of the river and harbor act of July 5, 1884.

Operations during the past fiscal year were of the same routine character as have been carried on since the canal was opened to traffic in 1871, viz, a custodian was present during the season of navigation to watch the passage of vessels, enforce regulations respecting traffic through the canal, and supervise all work required for the care and repair of the canal dikes. The expenditure on this account during the year was $3,348.15.

No record is kept of commerce through the canal, but it has been estimated from the customhouse records and other reliable statistics of general lake commerce that about forty million tons of freight passed during the calendar year 1899; there is no means of estimating, even approximately, the extent of passenger traffic.

(See Appendix O O 15.)

16. Clinton River, Michigan.—This stream empties into Anchor Bay, in the northwesterly part of Lake St. Clair, and before improvement had a channel depth of about 10 feet, except at several shoals, over which but 5 or 6 feet could be carried, and a broad flat at the mouth with a general depth of from 3 to 4 feet. In 1870–71 a channel 9 feet deep, 60 feet wide, and 2,700 feet long was dredged through this flat, but being left without works of protection it soon filled in again. In 1885 a project of general improvement was adopted, which provided for a through channel 8 feet deep to Mount Clemens (8 miles upstream), for a pile dike extending across the flat at the mouth to the curve of 10-

foot depth in the bay, and for revetments as needed above. The estimated cost, as modified in 1889, was $34,564.

The total expenditure to June 30, 1899, was $67,933.83, of which $25,500 was applied to occasional and scattering work done before the adoption of the general project of 1885, leaving $42,433.83 as the amount applied to the latter.

As a result of these expenditures the proposed 8-foot channel was obtained and kept in a fairly navigable condition, but the appropriations were at no time sufficient to permit the construction of protecting works of a permanent character, and in their absence the maintenance of the channel must depend on periodical dredgings.

No work was in progress during the past fiscal year except near the close, when an examination of the river was made to ascertain its present navigable condition; the expenditure was for this examination, general office expenses, and supervision.

The examination referred to above showed a general channel depth of 6 feet or over, and dredging will probably be called for to restore and maintain the depth required for convenient navigation. Funds on hand will suffice for this purpose, but an appropriation is likely to be needed for maintenance of the improvement during the year ending June 30, 1902.

The commerce of the river during the past four calendar years, as derived from the best data obtainable, is indicated in the following table, which shows the number of vessels entered and cleared, and their freight in tons:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1896	420	31,159	1898	263	29,085
1897	420	29,077	1899	384	35,525

July 1, 1899, balance unexpended	$7,130.17
June 30, 1900, amount expended during fiscal year	255.23
July 1, 1900, balance unexpended	6,874.94
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix O O 16.)

17. Detroit River, Michigan.—Operations under appropriations for this improvement were in progress from 1874 to October, 1897, first under projects for excavating a channel through the rocky reef known as the Limekiln Crossing, and after that under a project for deepening a section of the river just above, known as the Ballards Reef section. The result of these operations was to provide a channel 440 feet wide and 20 feet deep at the Limekiln Crossing, where the original depth was scant 13 feet, and to increase the channel depth through the Ballards Reef section from about 15 feet to 18 feet. The total expenditure for these improvements to June 30, 1899, was $793,110.41.

The river and harbor act of March 3, 1899, provided for further operations as follows:

> Improving Detroit River, Michigan, removing shoals from Detroit to Lake Erie: Continuing improvement, one hundred thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the same in accordance with the present project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate six hundred and sixty-one thousand five hundred dollars, exclusive of the amount herein and heretofore appropriated: *Provided further*, That the Secretary of War shall cause to be made and reported as early as practicable a survey of the Detroit River from Detroit to Lake Erie, with a plan and estimate of the cost of such improvement as will secure a safe and convenient channel twenty-one feet deep between said points, the expense of which shall be paid from the said appropriation for improving Detroit River.

The surveys called for by the above were completed during last winter, and preliminary report with plans and estimates for securing a safe and convenient channel 21 feet deep was submitted May 29, 1900, and is printed in House Doc. No. 712, Fifty-sixth Congress, first session; it is also herewith as Appendix O O 21. Projects were thereupon adopted for increasing the width of channel at Limekiln Crossing to 600 feet, and deepening it so as to provide a clear depth of 21 feet at ordinary low water; also to make a channel of the same width and depth through the Ballards Reef section. Contract for the work on the Limekiln Channel was entered into May 18, and work was commenced June 23, 1900, by drilling and blasting bed rock. Up to the end of the year 413 blast holes, aggregating 2,197 feet in depth, had been drilled, and 2,087 pounds of dynamite used in blasting, but none of the broken rock had been taken out up to date. The area covered by this drilling and blasting measures 1,500 square yards. No work had been commenced on the Ballards Reef channel, but advertisement inviting proposals was published May 29, 1900, bids opened June 13, and contract duly entered into July 3.

Work was in progress from April to June 30, by hired labor, with derrick scow and diving outfit, the object of which was to remove bowlders from the channel below Limekiln Crossing; the number of bowlders taken out was 780, aggregating 543 tons in weight. This work was scattered over an area measuring 66,200 square yards, and its result was to provide a clear depth of 20 feet where a limiting depth of only 18 feet previously existed.

It is probable that work on this improvement under the contracts already made and others that will be made during the current year, together with such work as will be done by hired labor and plant operated by the Government, will call for an expenditure of not less than $500,000 up to June 30, 1902; the amount now available is, in round numbers, $300,000. An estimate of $200,000 additional is therefore submitted for the year 1902.

The commerce that passed through the river during the calendar year 1899 has been estimated as about forty millions of freight tons, but it should be observed that the information on which the estimate is based is quite unsatisfactory, as it has been impossible to obtain accurate statistics having special reference to traffic through the Detroit River from the customhouse records or any other official or private source. It is deduced, however, from a careful consideration of all custom records on the upper and lower lakes, and indicates an increase of about 10,000,000 tons in the past five years.

July 1, 1899, balance unexpended		$100,000.00
Amount appropriated by sundry civil act approved June 6, 1900		200,000.00
		300,000.00
June 30, 1900, amount expended during fiscal year		4,477.16
July 1, 1900, balance unexpended		295,522.84
July 1, 1900, outstanding liabilities	$2,558.80	
July 1, 1900, amount covered by uncompleted contracts	172,520.00	
		175,078.80
July 1, 1900, balance available		120,444.04

Amount (estimated) required for completion of existing project	461,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O O 17.)

18. *Rouge River, Michigan.*—This stream originally had a channel depth of from 10 to 17 feet from its mouth to the point at which the Wabash Railroad Bridge crosses it, a distance of about 3 miles. During the years 1888 to 1892, inclusive, this part was improved by the Government so as to provide a minimum depth of 16 feet in a central channel 240 feet wide for a distance of 800 feet above the mouth, and thence 100 feet wide to the Wabash Bridge. The cost of this improvement, originally estimated, was $31,690.39.

The total expenditure to June 30, 1899, was $32,444.45, the result obtained being a 16-foot channel, as called for by the approved project, and its maintenance since 1892 to such extent as was necessary to meet the requirements of local commerce, but a gradual shoaling had taken place in the meantime such as to limit navigation to vessels drawing 13 feet or less. In the meantime Congress, by joint resolution approved April 11, 1898, had authorized an extension of the improvement up to the Maples road, a distance of about 1½ miles above the Wabash Railroad Bridge, limiting the expenditure for that purpose to $5,000.

Operations during the past fiscal year were confined to dredging 18,356 cubic yards for opening channels through two small shoals which were especially troublesome to navigation. The expenditure during the year was for this purpose, office expenses, and engineering contingencies.

Just before the close of the year proposals were invited, by advertisement, for redredging the channel as far up as the Wabash Bridge in order to restore a navigable depth of 16 feet and for dredging a channel 75 feet wide, 13 feet deep, from that point to the Maples road. The unexpended balance of appropriations will be exhausted by this work, and an additional appropriation should be provided by the next river and harbor act for future maintenance of the improvement.

The following statement indicates the commerce of this river during the past seven calendar years, as shown by data compiled from the best information obtainable:

	Tons.		Tons.
1893	73,732	1897	125,373
1894	47,106	1898	127,745
1895	114,090	1899	93,394
1896	123,495		

July 1, 1899, balance unexpended	$14,245.55
June 30, 1900, amount expended during fiscal year	642.69
July 1, 1900, balance unexpended	13,602.86
July 1, 1900, outstanding liabilities	2,149.18
July 1, 1900, balance available	11,453.68
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix O O 18.)

EXAMINATIONS AND SURVEYS REQUIRED BY THE RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Lieut. Col. G. J. Lydecker, Corps of Engineers, and reports thereon submitted:

1. *Preliminary examination and survey of Mackinac Harbor, Michigan.*—Lieutenant-Colonel Lydecker submitted reports dated May 15, 1899, and April 20, 1900, respectively, with plan for improvement at an estimated cost of $80,000, and in his opinion the harbor is worthy of improvement to this extent by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 646, Fifty-sixth Congress, first session. (See also Appendix O O 19.)

2. *Preliminary examination and survey of Cheboygan Harbor, Michigan.*—Lieutenant-Colonel Lydecker submitted report dated April 14, 1900, with plan for improvement at an estimated cost of $15,500, and in his opinion the harbor is worthy of improvement by the General Government to the extent indicated. The report was transmitted to Congress and printed in House Doc. No. 636, Fifty-sixth Congress, first session. (See also Appendix O O 20.)

3. *Survey of Detroit River from Detroit, Mich., to Lake Erie.*—Lieutenant-Colonel Lydecker submitted preliminary report May 29, 1900. Three plans for improvement are under consideration, and it is expected that final report, with detailed plans and estimates, will be submitted in time for transmission to Congress at its next session. The preliminary report was transmitted to Congress and printed in House Doc. No. 712, Fifty-sixth Congress, first session. (See also Appendix O O 21.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *St. Clair Flats Canal, in Lake St. Clair, Michigan, with a view to doubling the capacity of the so-called St. Clair Flats Canal.*

2. *Detroit River, Michigan, with a view to obtaining a sufficient depth of water in the channel on the west side of Grosse Isle.*

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE ERIE WEST OF ERIE, PA.

This district was in the charge of Col. Jared A. Smith, Corps of Engineers.

1. Monroe Harbor, Michigan.—The harbor of Monroe, Mich., is in the Raisin River, at the extreme westerly end of Lake Erie. In its natural condition the river flowed into the lake through several ponds and tortuous creeks forming a delta in a marsh, most of which was submerged at ordinary stages of lake level and was impassable on foot except when frozen.

The improvement planned in 1834, and practically completed in 1845, consisted in dredging a new and direct channel 100 feet wide and 10 feet deep across a part of the marsh a distance of 4,000 feet to the lake, protecting the sides of the canal with a sheet piling of oak secured to oak piles and waling pieces, and protecting the entrance from the lake by piers of timber, piles, and crib work, filled with stone, extending to a depth of 10 feet in the lake.

The city of Monroe further improved the river channel by cutting a canal 1,400 feet long of same cross section and protected sides as the canal constructed by the United States. This canal made the channel much shorter and more direct to the wharves, which are 2½ miles from the lake and somewhat distant from the city proper.

The expense of construction and maintenance to time of completion in 1845 was	$110,000.00
From 1845 to June 30, 1899, the expense was, for maintenance	130,515.27
For dredging channel 14 feet deep between piers and over bar in 1897 and 1898	5,000.00
Total of expenditures to June 30, 1899	245,515.27

At that date there had been a narrow channel of 14 feet depth between the piers and to the deeper water in the lake, but it had shoaled somewhat, so that the reliable depth did not exceed 13 feet.

Piers outside of shore line were in good condition, but all of the canal revetment of sheet piling, piles, and waling pieces was decayed above water and much worn and displaced below water.

The appropriations of June 3, 1896, and March 3, 1899, were for "continuing improvement by dredging the channel."

The project for repairing revetment to the canal, with the estimate of cost, was submitted in 1891. There have been no appropriations applicable to the project since that of August 18, 1894. The completion of project is not now recommended.

A contract for continuing the deepening of channel by dredging was executed in October, 1899. Work was commenced June 6, 1900, and will be completed in July.

A survey of the channel over the bar, made May 25, 1900, indicated a least depth of 12.8 feet in the middle. The bar had encroached upon the channel from both sides, and the chart indicates that the depths dredged outside of the bar will not be permanent. Depths in river generally exceed 9 feet.

The commerce of Monroe is very small. The greater number of vessels arriving and departing do not proceed up the river to the wharves, but stop at the piers, where there is a small summer resort.

July 1, 1899, balance unexpended		$5,000.00
June 30, 1900, amount expended during fiscal year		171.76
July 1, 1900, balance unexpended		4,828.24
July 1, 1900, outstanding liabilities	$2,705.95	
July 1, 1900, amount covered by uncompleted contracts	1,825.00	
		4,530.95
July 1, 1900, balance available		297.29

(See Appendix P P 1.)

2. *Toledo Harbor*, *Ohio*.—The harbor of Toledo is in the Maumee River. The wharf frontage on the river extends over a distance of about 3 miles, the lower end of which is about 4 miles above the mouth of the river, at the head of Maumee Bay.

Originally the channels in the river were much better than in the bay, having minimum depths of 14 to 16 feet, while in the bay the least depths were 8.5 feet, and the maximum depth for most of the distance was but 12 feet.

In 1866 a project was adopted to dredge the channels of deepest water in the bay to a depth of 12 feet. The project was amended from time to time by increasing the depths until 1887, when the old indirect channel had been dredged to 16 feet, but had filled so that the minimum depth was but 15 feet.

In 1887 a project was adopted for a straight channel through Maumee Bay, with a depth of 17 feet and a bottom width of 200 feet. The estimate of cost, including dikes or other channel protections, was $1,875,000.

The project for straight channel was amended in 1893 by increasing the width of outer section about 3 miles long to 300 feet. Since 1892 the improvement has been extended to include the Maumee River.

The river and harbor act of March 3, 1899, appropriated $150,000 for—

> Improving harbor at Toledo, Ohio, by providing a straight channel through Maumee River and Bay four hundred feet in width and twenty-one feet deep, in accordance with the project dated December sixteenth, eighteen hundred and ninety-seven, * * * *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the said project, to be paid for as appropriations may from time to time be made by law, not to exceed eight hundred thousand dollars, exclusive of the amount herein and heretofore appropriated.

Of the amount appropriated March 3, 1899, the sum of $100,000 was allotted for operating and maintaining United States dredge plant to dredge the channels south of the Wheeling and Lake Erie Railroad Bridge. Before the close of the past fiscal year a continuous contract had been executed for completing the remainder of the work.

The total of expenditures for improving and maintaining channels in Maumee Bay and River, 1866 to June 30, 1899, was $1,624,483.83.

The channel in Maumee Bay, about 7½ miles long, had been dredged to a width of 200 feet and a depth exceeding 17 feet throughout. Most of the channel had been several times redredged to restore depths previously obtained. Two shoals in the river, the "Crossing" and "Lake Shore Shoals," a length of about 3,500 feet each, had been dredged to a width of 400 feet and depth of 18 feet.

The United States dredge plant has been employed upon the work during all of the last fiscal year, except when temporarily transferred under emergencies to work at Sandusky Harbor, as explained in report for that improvement.

Dredging in straight channel through Maumee Bay under continuous contract was commenced May 1, 1900. At the close of the year work was in progress with three large dredges.

The entire length of channel to be widened and deepened in the river and bay is so great that the completion of one or more divisions will produce no material change in the draft of vessels which can enter the harbor until the greater depth has been extended throughout the entire distance.

Vessels drawing 17 feet have no difficulty in passing in and out when the water is at or near the stage of mean level.

It is proposed to first increase the depth of present channel of 200 feet width to the depth of 21 feet, and subsequently to complete the channel by widening the part thus made to 400 feet.

The actual freights entering and leaving Toledo Harbor in 1899 exceeded two and a half millions of tons. The tonnage of Toledo Harbor has regularly increased as increased facilities have been provided.

July 1, 1899, balance unexpended		$147,716.17
Amount appropriated by sundry civil act approved June 6, 1900		132,500.00
		280,216.17
June 30, 1900, amount expended during fiscal year		36,469.62
July 1, 1900, balance unexpended		243,746.55
July 1, 1900, outstanding liabilities	$13,616.99	
July 1, 1900, amount covered by uncompleted contracts	848,750.00	
		862,366.99
Amount (estimated) required for completion of existing project		667,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix P P 2.)

3. *Port Clinton Harbor, Ohio.*—The harbor of Port Clinton, Ohio, is in the Portage River near its mouth. The Portage River flows into Lake Erie at a point about 13 miles west of Sandusky by land and 22 miles by the water route. Previous to 1873 the depth at the mouth rarely exceeded 5 feet, and the available depth inside did not exceed 7 feet.

In 1873 a channel 20 feet wide and 8 feet deep was dredged from the mouth of the river through the bar to the lake. In 1874 a fence was built upon the point north of the river mouth to stop the drifting sand. In 1875 a plan was adopted to protect both sides of the channel from the river mouth to water of sufficient depth in the lake.

The work consisted mainly of sheet piling of oak plank, secured and reenforced by oak piles, with heavy oak waling pieces. The pierhead of east pier was a solid construction of piles and stone, and 720 linear feet of west pier consisted of a substructure of piles with superstructure of timber-crib work, both filled with stone. The estimated cost was $90,000.

The piers had been extended to a depth of 10 feet in the lake in 1883, and no further extension has been considered necessary. The channel was dredged to a depth of 10 feet over a width of 100 feet between piers and a width of 200 feet inside the shore line in 1893 and 1894. The natural conditions have maintained the depth since dredging. The sheet piling of piers has also been partially protected by riprap stone piled against it on both sides in 1898.

Since 1894 the project for improving this harbor has been limited to the maintenance of channel protections as far as could be done upon the unexpended balance of estimate of 1875. The project covers merely the reenforcing of old wooden channel protections by banks of stone, so placed as to be permanent. Amount expended for construction and maintenance, 1873 to June 30, 1899, $87,582.77.

No work of improvement has been carried on since 1898. The expenses of the past year have been for printing, advertising, examination of channel, and other contingencies.

A survey of the channel was made June 25 and 26, 1900. The depths throughout exceed 10 feet, except in a single very small place in the harbor, where there is a depth of but little more than 9 feet.

In September, 1899, proposals were invited for continuing the improvement by reenforcing jetties and piers with stone. Bids were to have been opened October 2, 1899, but none were received.

Specifications were again prepared and proposals have been invited for the work.

The commerce of Port Clinton Harbor is very small and entirely local. The receipts in 1899 were 5,133 tons. No shipments by water were reported.

July 1, 1899, balance unexpended	$6,417.23
June 30, 1900, amount expended during fiscal year	80.45
July 1, 1900, balance unexpended	6,336.78
July 1, 1900, outstanding liabilities	26.68
July 1, 1900, balance available	6,310.10
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix P P 3.)

4. *Sandusky Harbor, Ohio.*—The harbor of Sandusky is in the lower part of Sandusky Bay along the city front, the nearest part to the lake being about 2 miles from the bar which divides the waters of the bay from the lake.

Originally the harbor depths were only those of the bay, which was about 10 feet deep along the city front, and 9 to 12 feet thence to the lake. In the part known as the "Deep Hole," at Cedar Point, the depth exceeded 18 feet for a length of about 1 mile, and the greatest depth exceeded 40 feet.

In 1826 an appropriation of $400 was made for a survey. The first improvement was made in 1844 by the construction of a dam across a breach in the long point which, in 1826, extended in a peninsula from the mainland on the north nearly to the Deep Hole channel at Cedar Point. With this exception all improvements previous to 1896 consisted in deepening natural channels, making a new straight channel from city front to Cedar Point, and in dredging and removing bowlders from dock channel along city front.

In 1896 a project was adopted to construct a jetty of stone and brush extending into the lake from Cedar Point, and to construct a dike on the opposite side, with a view to obtaining a permanent channel of 18 feet depth over the bar.

Under provisions of the river and harbor act of March 3, 1899, the project of 1896 was extended to include a prolongation of the jetty and dike; to protect the bank of channel and point of bar near the light-house with mattresses of brush covered with stone; to extend a small work of brush and stone along the top of bar from light-house westward; to check the erosion by currents over the top of bar, and to construct two other works for directing the incoming and outgoing currents (see Annual Report of the Chief of Engineers for 1898, pp. 2708 and 2717, with maps).

The total of expenditures for improving Sandusky Harbor, 1844 to June 30, 1899, was $477,229.38.

The channels in the bay had a mean depth of 17 feet over a width of 100 feet or more from Cedar Point to the city front, with somewhat greater depths in mid-channel. Along the dock channel, on city front, the depths generally exceeded 16.5 feet. On channel over outer bar the least depth was 18 feet, and the channel exceeding 17 feet in depth was 150 feet wide in the narrowest place, while the average width exceeded 200 feet. The east jetty was completed to a point 1,775 feet from shore in October, 1897.

Under a contract previously awarded, dredging was commenced in August, 1899, and was continued throughout the year except in winter months.

A United States dredge was temporarily employed in an emergency to dredge channel on bar July 18 to August 4, and again in May, 1900. Work of brush mattresses and stone, under contract, was in progress from the latter part of July to end of fiscal year except during winter months.

June 30, 1900, the minimum depth in channel over the outer bar exceeded 18.5 feet, and most of the channel had depths exceeding 20 feet. Inside channels exceeded 17.5 feet in depth to city front and along city front dock channel had depth of 16 to 17 feet. Vessels drawing 17 feet could reach the wharf front and land at all of the wharves where heavy freights were handled.

The effect of the jetty and other work of brush and stone has been very noticeable in increasing both width and depth of channel over outer bar. The completion of these works will, without doubt, result in securing and maintaining a permanent channel of a depth exceeding 20 feet throughout.

The commerce of Sandusky is increasing. In the year 1899 freights reported by water amounted to 1,190,317 tons.

July 1, 1899, balance unexpended	$79,562.62
June 30, 1900, amount expended during fiscal year	33,286.91
July 1, 1900, balance unexpended	46,275.71
July 1, 1900, outstanding liabilities	7,053.68
July 1, 1900, balance available	39,222.03
Amount (estimated) required for completion of existing project	345,796.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix P P 4.)

5. *Huron Harbor, Ohio.*—In 1826, when the improvement of the mouth of the Huron River was undertaken in order to make it a harbor, the mouth of the stream was practically closed by a sand bar.

The project of improvement was to construct two parallel piers about 140 feet apart to confine the currents so that the scour would maintain the channel.

The piers have been extended and repaired, and the channel has been deepened by dredging, without any radical change in the principle of improvement, though methods of construction have necessarily advanced with the later conditions.

The latest project for the improvement, approved in 1890, was to extend the piers to the contour of 16 feet depth in the lake with a view to obtaining that depth in the channel. The estimated cost of construction only, as revised in 1893 for work then remaining, was $125,000.

The total expenditure for construction and maintenance of this harbor to June 30, 1899, was $172,273.71. In addition to the expenditure of funds appropriated by Congress, the channel had been considerably improved by the Wheeling and Lake Erie Railway Company, under authority granted by the Secretary of War.

No work of improvement has been carried on during the past fiscal year. June 24, 1900, a survey showed that the mid-channel depths were nowhere less than 19 feet from inner end of piers to deeper water of the lake.

The officer in charge of the improvement does not recommend the continuance of the improvement under the limitations of the present project. The reasons given are that the channel depths are already greater than contemplated by the project; that the width of channel between piers is too small for convenient entrance, handling, and passing of the large steamers now employed on the lakes, and that the extension of piers on present lines will result in less benefit than may be obtained by the adoption of a different plan which will provide and maintain a greater width and depth at the entrance. The channel depths contemplated by the project are too small, because they are considerably less than the usual draft of large steamers loaded with ore or coal which are the principal freights at Huron Harbor. A depth of 20 feet at mean lake level is not too much.

In 1898 the actual freights of ore and coal at Huron Harbor exceeded 450,000 tons, with a tendency to increase.

Owing to the inadvisability of extending the piers, and the fact that considerable portions of the old piers are in very bad condition, the amount of appropriation of March 3, 1899, for this improvement is to be expended for maintenance by rebuilding a part of west pier. Proposals for the work were invited by public advertisement dated June 21, 1900.

It is estimated that a section 186 feet long may be rebuilt with funds now available. A further length of about 1,000 feet of west pier and 720 feet of east pier is in such bad condition that it must soon be rebuilt. The cost is estimated to be at the rate of $120 per foot, making a total of $206,400.

July 1, 1899 balance unexpended	$25,000.00
July 1, 1900, balance unexpended	25,000.00
July 1, 1900, outstanding liabilities	58.55
July 1, 1900, balance available	24,941.45
Amount (estimated) required for completion of existing project	117,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix P P 5.)

6. *Black River (Lorain) Harbor, Ohio.*—In its natural condition the depth of water at the mouth of Black River did not exceed 3 feet. The mouth was occasionally closed by a sand bar, and it was in this condition in 1828 when the first project for improvement was adopted.

The project of improvement was to construct parallel piers of timber work filled with stone to check the movement of sand, and by confining the currents to maintain an increased depth in the channel. The piers rested upon or very near the surface of the bottom of the lake. The piers have been repaired, portions have been rebuilt, and additions have been made to extend the outer ends to deeper water, keeping pace as far as possible with the changing conditions and increasing demands of commerce with no radical change in original plans until 1897.

The east pier was extended 40 feet in 1893, and west pier 72 feet in 1895. All subsequent expenditures to June 30, 1899, were for maintenance by repairs or rebuilding.

Expenditures for construction and maintenance from 1828 to June 30, 1899, were $292,204.77.

The east pier was then approximately 1,562 feet long, and the west pier 1,896 feet long. There was a good channel of 18.5 feet depth at mean lake level.

In compliance with requirements of the river and harbor act of June 3, 1896, a report of a survey and an estimate of cost of improvements, with a view to providing better access to the harbor and the safety of boats therein, was submitted to the Secretary of War November 1, 1897. The report was printed in House Doc. No. 131, Fifty-fifth Congress, second session, and in the Annual Report of the Chief of Engineers for 1898, page 2717. Estimated cost was $695,500.

Two breakwaters were recommended upon the larger (B) of two plans which were shown upon map with the report. The project also includes extending east pier 100 feet, rebuilding 1,880 linear feet of old piers, and dredging protected areas to a depth of 20 feet.

The river and harbor act of March 3, 1899, appropriated $50,000 for the improvement and authorized the making of contracts to complete the project (B) "not to exceed in the aggregate $600,000, exclusive of the amount herein and heretofore appropriated."

As the deepening of the channel to 20 feet under the project was immediately needed, a separate contract was executed in October, 1899, for that part of the project. Dredging was commenced in November, 1899, and will be completed early in the season of 1900.

There is now a channel depth of 20 feet between the piers and extending to deeper water in the lake.

Subsequent to the date at which the estimate of cost of project was submitted, prices of materials were very much advanced, and in the item of pine timber, the difficulty of obtaining large amounts of the sizes necessary for such construction grew to be practically insurmountable.

It therefore became necessary to devise plans in which the breakwaters should be entirely of stone, or at least should avoid the use of timber in superstructures.

March 17, 1900, proposals were invited for the entire work necessary to complete the project, except the dredging which had been previously provided for under a separate contract. Proposals were opened April 16. The lowest bid received exceeded in the aggregate the limit authorized by law, and all proposals were therefore rejected.

Under authority granted by the emergency act of June 6, 1900, proposals are to be invited for completing all of the project which now remains to be let by contract, except the main part of east breakwater. A continuous contract will be awarded for completing the extension and rebuilding of piers, and constructing the west breakwater and the two pierheads, provided the proposals received are at such prices that the work can be completed at a cost not exceeding the limit fixed by law. The limit of cost thus fixed for the part of project for which proposals will soon be invited is $493,350.

The estimated cost of constructing east breakwater of stone is $190,000, which added to amount authorized for completing the other part of project, including dredging ($22,000), makes the estimate for entire project $705,350, of which $175,000 has been appropriated. For detailed statement attention is invited to report of officer in charge of the improvement (see Appendix P P 6).

The commerce of the harbor of Lorain, Ohio, has been constantly increasing. In 1899 the receipts by water exceeded 1,100,000 tons; the total of receipts and shipments was 1,423,157 tons.

July 1, 1899, balance unexpended		$50,000.00
Amount appropriated by sundry civil act approved June 5, 1900		125,000.00
		175,000.00
June 30, 1900, amount expended during fiscal year		8,395.58
July 1, 1900, balance unexpended		166,604.42
July 1, 1900, outstanding liabilities	$2,333.26	
July 1, 1900, amount covered by uncompleted contracts	9,000.00	
		11,333.26
July 1, 1900, balance available		155,271.16
Amount (estimated) required for completion of existing project		530,350.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P P 6.)

7. *Cleveland Harbor, Ohio.*—The harbor of Cleveland, Ohio, consists of two very distinct parts. The main portion, which is used for business purposes, is in the navigable portion of the Cuyahoga River

and a branch known as the "Old River Bed," all inside of the present shore line. All of the channel above the bridge of the Lake Shore and Michigan Southern Railway, which occupies a position practically coincident with the shore line of 1825, has been improved and maintained under the direction of the city authorities.

Previous to 1825 no improvements had been made and the mouth of the river had no permanent location nor reliable depth. The river, at different times, flowed into Lake Erie at various points, the extremes of which were more than three-fourths of a mile apart. This condition was caused by the sand which drifted and formed a long point or spit projecting from the east side and forcing the river to take its course westward to the end of the point. At times the mouth of the river was closed entirely during brief intervals until a freshet or other increased flow would result in a new break through the bar.

In 1826, when improvements were first undertaken, the spit extended westward beyond the present west pier, and the middle of the river was about 700 feet west of its present location. The plan of improvement contemplated rectifying the channel so that it would lead more directly into the lake, and to make the new location permanent by piers to confine the channel across the bar and into the lake on each side.

The piers were repaired and extended, parts were rebuilt, and the channel was made deeper and maintained by dredging, as necessities arose, with no change in the general method of improvement until 1875, at which time the total expenditure had been $346,881.61.

In 1875 a project was adopted for a breakwater in 5 fathoms of water. West breakwater was commenced in 1876 and completed in 1883, a total length of 7,130 feet. East breakwater was commenced in 1888 and continued at intervals until 1893, when its length was 2,494.5 feet. In 1895 an opening of 200 feet was made in shore arm of west breakwater as a sanitary measure. In 1896 a project for completing certain improvements was approved by Congress, and contracts for the work were authorized at a total cost not to exceed $1,354,000.

These improvements, embodied in the latest project, involve the completion of east breakwater, covering an extension of about 3,000 feet; removing superstructure of old west breakwater to a depth of 2 to 3 feet below water level and replacing it with a superstructure of concrete masonry; reenforcing cribs below the masonry; sheathing face of east breakwater; removing and rebuilding east and west piers, and widening the mouth of the river. The part of project which includes river widening was authorized upon the basis of report and estimate predicated upon an assurance that the land necessary for the purpose would be transferred to the United States free of cost.

In July, 1898, a portion of the land extending to the lake from a line about 100 feet north of the railroad, was donated and deeded to the United States by the city of Cleveland.

The river and harbor act of March 3, 1899, appropriated $75,000 for dredging. A contract for dredging in the harbor to a depth of 21 feet was approved July 7, 1899.

The total of all expenditures for improving Cleveland Harbor from 1825 to June 30, 1899, was $1,949,076.85.

June 30, 1899, under the project of 1896, the riprap foundation of east breakwater had been completed, and one crib 216 feet long of east breakwater extension had been placed and filled with stone. The superstructure of west breakwater had been removed to a mean depth of 2.5 feet below mean water level and replaced with a concrete superstructure 1,200 feet in length which was complete, and 330 feet more in various stages of progress. The face of timber walls of west breakwater had been sheathed with oak over a length of about 1,400 feet and waling strips of oak had been secured to concrete on harbor side. Foundations for a length of 1,440 linear feet of new west pier had been prepared and five cribs each 288 feet in length had been sunk in position and filled with stone. A buttress crib 100 feet long and 60 feet wide had also been placed in position on west side of new pier, and a storehouse had been placed upon it.

Foundation for east breakwater had been completed.

The main channel to harbor had sufficient depth to accommodate the largest vessels, but the areas inside of breakwaters on each side of channel had been very much filled, so that the water was so shallow as to cause great inconvenience.

During the past fiscal year, under the contract for west breakwater, the work has progressed so that at the end of the year the entire length completed was 1,140 feet on shore arm and 1,250 feet on the lake front. A farther distance of 100 feet on shore arm was completed except parapet.

The east breakwater has been extended 864 feet.

The west pier has 821.31 linear feet of concrete superstructure completed; the concrete blocks are in position on the remaining part of the total length of 1,440 feet of cribs.

Under the contract for dredging the channel between piers north of railroad bridge, and thence to harbor entrance, and nearly the entire area between east breakwater and harbor line, have been dredged to a depth of 21 feet.

As the appropriations for the works under continuous contract and for dredging were made under different acts of Congress for different purposes, the money statements are separately submitted.

The emergency river and harbor act of June 6, 1900, provided for a preliminary examination and survey of Cleveland Harbor, Ohio, "with a view to the further improvement of said harbor: First, by such additional construction or extension as may be necessary to provide a safer and better entrance for vessels at the main entrance to the breakwater of said harbor; second, to provide such additional harbor room as may be found necessary by an extension eastward of the breakwater now under construction in said harbor."

The depth of water at Cleveland Harbor is sufficient for the largest vessels on the lakes when the water is smooth. In storms difficulty is experienced at the entrance because of increased seas and strong currents caused by reactions on the breakwaters.

The freight tonnage of Cleveland Harbor is very large. In 1899 the total of receipts and shipments reported was 7,390,921 tons. The tonnage is increasing.

PROJECT UNDER CONTINUOUS CONTRACT.

July 1, 1899, balance unexpended		$548,554.76
Amount appropriated by sundry civil act approved June 6, 1900		175,000.00
		723,554.76
June 30, 1900, amount expended during fiscal year		208,090.83
July 1, 1900, balance unexpended		515,463.93
July 1, 1900, outstanding liabilities	$23,556.02	
July 1, 1900, amount covered by uncompleted contracts	569,678.65	
		593,234.67

Amount (estimated) required for completion of existing project	353,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

DREDGING CHANNEL TO A DEPTH OF 21 FEET.

July 1, 1899, balance unexpended		$75,000.00
June 30, 1900, amount expended during fiscal year		57,111.12
July 1, 1900, balance unexpended		17,888.88
July 1, 1900, outstanding liabilities	$4,973.61	
July 1, 1900, amount covered by uncompleted contracts	12,000.00	
		16,973.61
July 1, 1900, balance available		915.27

Amount (estimated) required for completion of existing project	160,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	160,300.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P P 7.)

8. *Fairport Harbor, Ohio.*—The harbor of Fairport, Ohio, is in the Grand River, at and near its mouth. Before the improvement was commenced the depth across the bar was variable and uncertain, and when the improvement was undertaken in 1825 the mouth of the river was entirely closed by the sand bar.

The original project of improvement consisted of parallel piers of crib work filled with stone, about 200 feet apart, extending across the bar into the lake to confine the currents, check the drifting sand, and thus maintain a navigable depth of water in the channel. The piers have been repaired and rebuilt as necessities have required, the channel has been deepened, and the depths many times restored by dredging.

The cost of maintenance, especially of dredging for restoration of channel depths, has been a very large item in the total expenditures, because at this place the formation of bars across the channel occurs to a greater extent than at any other port on Lake Erie.

The last extension of piers was in 1893, since which all expenditures have been for maintenance.

The total of expenditures, 1825 to June 30, 1899, was $378,808.86.

The west pier was then approximately 2,370 feet long, and the east pier 1,765 feet long from original shore line. At present the shore line on west side, owing to the accumulation of sand, is about 1,700 feet outside its original position. On the east side a length of about 650 feet of the pier is in the possession of railroad and dock companies, which have repaired and rebuilt parts at their own convenience. The channel between piers usually has depths from 19 to 20 feet.

A dredge was employed in July and August, 1899, and from April 24 to June 11, 1900, in restoring channel depths. June 30, 1900, the depth in channel had been restored to a depth of 20 feet over full width between piers and 250 feet wide outside of piers across the first bar. The channel across the second bar is very narrow, and dredging is now much needed. Vessels can enter the harbor drawing 18 feet of water, the mid-channel depth being nowhere less than 20 feet at mean lake level.

Expenditures of the fiscal year have been for maintenance of channels. An allotment of $3,000, from appropriation by the emergency river and harbor act of June 6, 1900, was made July 31, 1900, for dredging in Fairport Harbor.

The river and harbor act of June 3, 1896, appropriated $30,000 for the improvement, and provided that of the amount "not less than twenty thousand dollars shall be applied toward the construction of a breakwater according to the project submitted April third, eighteen hundred and ninety-six."

The project contemplates the construction of two breakwaters, converging toward the lake. The expenditure of $20,000 only, to commence the breakwaters, would not permit of constructing a section sufficiently large to be of any practical service, and its proportional cost would be increased. It would furthermore be subject to injuries and deterioration before it would become of service. The expenditure of this sum was therefore deferred until additional funds for the purpose were made available.

The act of March 3, 1899, having appropriated $100,000 for continuing the improvement, a contract was approved August 4, 1899, for constructing a section of west breakwater.

The amount available for construction has been necessarily limited to approximately $112,000, because of expenses of maintenance. The estimated amount which can be built with available funds is 864 feet. This will be completed during the season of 1900.

Owing to the great advance in price of timber and iron, it has been found necessary to use other materials in the construction of the breakwaters after completing the work now under contract. This has necessarily increased the estimate of cost for completion of the project.

Fairport Harbor has a large receiving and shipping business in iron ore and coal, with a considerable amount of grain and general merchandise. The total of receipts and shipments in 1899 amounted to 1,720,283 tons.

A considerable expense has heretofore been required annually for dredging to maintain channels. Old piers are also in need of extensive repairs and rebuilding. For full details attention is invited to the report of the officer in charge of the improvement.

July 1, 1899, balance unexpended		$127,064.67
June 30, 1900, amount expended during fiscal year		7,591.06
July 1, 1900, balance unexpended		119,473.61
July 1, 1900, outstanding liabilities	$4,557.11	
July 1, 1900, amount covered by uncompleted contracts	112,000.00	
		116,557.11
July 1, 1900, balance available		2,916.50
Amount (estimated) required for completion of existing project		480,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		210,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix P P 8.)

9. *Ashtabula Harbor, Ohio.*—Previous to 1826 the natural conditions at the mouth of the river were widely varied under the action of storms on the lake and of freshets in the river. The greatest possible depth was 9 feet to underlying rock near the shore line, and the depth was at times reduced to 2 feet or less by the formation of sand bars.

The original project for the improvement adopted in 1826 consisted of constructing two parallel piers commencing near the shore line and extending outward into the lake, with a view of checking the movement of sand along the shore and of confining the currents of the river to remove the bar across the channel.

The piers were subsequently repaired, renewed, and extended, and the channel was made deeper by dredging the sand and shaly rock, without any radical change in the principle or plan of the work until 1895.

The following extract is taken from the Annual Report of the Chief of Engineers for 1898, page 450:

> In 1891 the depths were 17 feet and the original plan was modified by adopting a project to widen the outer part of channel to 213 feet, to extend piers to a depth of 22 feet, and to remove the rock to a depth of 20 feet.
>
> The project of 1891 was but partially carried out when the river and harbor act of August 18, 1894, provided for a survey with a view to making it a harbor of refuge and increasing its capacity for the purposes of commerce. The report was submitted to Congress in Annual Report of the Chief of Engineers, 1895, pages 3122 to 3126, with map. The project modified the previous plan in regard to length of piers, and recommended the construction of two breakwaters converging toward the lake, the outer ends 400 feet apart in water 29 feet deep.

The amount expended for construction and maintenance from 1826 to June 30, 1899, was $662,888.56.

The widths between piers north of Lake Shore Canal and Slip had, previous to June 30, 1899, been increased to 213 feet, and all the rock and overlying material had been removed to a depth of 20 feet, extending from the county bridge to deep water of the lake. A section of west breakwater 432 feet long at its southerly end had been completed.

During the year ending June 30, 1900, the dredging of bar for restoration of channel, which was in progress at the beginning of the fiscal year, was completed. The section of breakwater already constructed has very noticeably modified the bar and made its formation less rapid. In the spring of 1900 the formation was sufficient to be an encroachment upon and injury to the channel, but not enough to prevent the entrance and departure of loaded vessels having a maximum draft of 18 feet.

Owing to the great advance in prices of materials entering into the construction of breakwaters of timber, iron, and stone, added to the scarcity of suitable timber, the officer in charge of the improvement recommended in 1899 that a part of the work should be constructed entirely of stone dumped in place and covered with a heavy paving. The subject was referred to a Board of Officers of the Corps of Engineers, to whose report, in appendix herewith, attention is invited.

The preparation of new plans and specifications for completing the work under continuous contract was completed, and in April, 1900, a contract was awarded to the lowest bidder for the work.

The breakwaters are to be of stone, with pierheads of timber, iron, and stone, surmounted by concrete, as bases for light-houses or beacons at the outer ends.

Ashtabula Harbor is one of the largest receiving and shipping ports for coal and iron on Lake Erie. In the year 1900 the total of receipts and shipments amounted to 4,652,232 tons.

The completion of the breakwaters will insure an entrance in deep water to a protected area outside of the piers, and will doubtless entirely prevent the formation of such bars as are due to the action of seas from storms on the lake.

Work under contract is to be commenced before the close of the season of 1900.

The cost of maintenance as estimated includes the rebuilding of most of the west pier, and repairs to the remaining portion in addition to an estimate of $8,000 for maintenance of channel depths.

An allotment of $3,000 from appropriation by emergency river and harbor act of June 6, 1900, was made June 30, 1900, for dredging.

July 1, 1899, balance unexpended		$49,512.65
Amount appropriated by sundry civil act approved June 6, 1900		110,000.00
		159,512.65
June 30, 1900, amount expended during fiscal year		6,520.82
July 1, 1900, balance unexpended		152,991.83
July 1, 1900, outstanding liabilities	$7.75	
July 1, 1900, estimated amount covered by uncompleted contracts	407,410.11	
		407,417.86
Amount (estimated) required for completion of existing project		320,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	200,000.00	
For maintenance of improvement	10,000.00	
		210,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix P P 9.)

10. Conneaut Harbor, Ohio.—The improvement of Conneaut Creek was commenced under an appropriation approved March 2, 1829, for improving the creek by removing the bar at its mouth. Under ordinary conditions the depth over the bar was about 2 feet.

The method of improvement was by piers of timber and stone to confine the channel across the bar. From 1829 to 1880 there was expended in construction and maintenance the sum of $112,629.39. No further appropriations were made until 1892.

In 1893 the piers were old, worn, and rotten, and the channels had refilled and were too shallow to float anything larger than the sailboats used in fishing.

Under the acts of July 13, 1892, and February 24, 1893, a project was adopted to construct parallel piers 200 feet apart and of sufficient length to extend to a depth of 17 feet in the lake.

The present project, adopted in 1896, contemplates the construction of two breakwaters converging toward the lake in such manner as to deflect the seas from the entrance, so that the formation of a bar of sand, moved by action of the waves, will be prevented, and the entrance be made easy for vessels. The project also contemplates a small extension to east pier and the dredging of protected areas to a depth of 20 feet.

The estimated cost, exclusive of maintenance, is $610,000.

The amount expended for construction and maintenance to June 30, 1899, was:

1829 to 1880	$112,629.39
1892 to 1899	120,127.25
Total	232,756.64

The channel 200 feet wide between piers had been made 20 feet deep, but is subject to variations due to the drifting of sand, so that dredging is required for its maintenance.

Four hundred feet of west pier 24 feet wide, 600 feet of the east pier 18 feet wide, 526 feet of pile revetment inside of shore line, and 282 feet of shore end of west breakwater 24 feet wide, with base 36 feet wide, had been completed with the close of the season of 1897.

In the summer of 1898 the Pittsburg, Bessemer and Lake Erie Railroad Company, whose terminal is at the harbor, removed all the old pier and underlying rock in the channel to a depth nowhere less than 20 feet.

June 30, 1899, there was a good channel to and between piers exceeding 18 feet in depth. In June and July, 1899, the channel through the bar near outer end of piers was restored to a depth of 20 feet by dredging.

In October, 1899, the bar across channel had again been formed and it was once more restored by dredging.

A contract was approved August 9, 1899, for continuing construction of west breakwater as far as practicable with funds available for the purpose; the amount is about $88,000 in addition to expense of engineering and superintendence, with an amount to cover possible losses in course of construction.

The length of breakwater which can be built during the season of 1900 is estimated to be 756 linear feet; it is to be completed on or before November 15, 1900.

All expenses of the past year have been for maintenance.

In 1892 there was no commerce at this port. In 1899, 865 vessels entered, 868 vessels departed, and the total of freights by water was 2,611,711 tons. The value of exports alone was $1,394,666.

Vessels could enter and leave the harbor in June, 1900, drawing 18 feet of water. The channel had, however, been much narrowed and made very shoal on the sides, so that dredging was needed for its restoration. An allotment of $3,000, from appropriation by the emergency river and harbor act of June 6, 1900, was made June 30, 1900, for dredging in Conneaut Harbor.

July 1, 1899, balance unexpended		$99,872.75
June 30, 1900, amount expended during fiscal year		4,707.19
July 1, 1900, balance unexpended		95,165.56
July 1, 1900, outstanding liabilities	$27.68	
July 1, 1900, amount covered by uncompleted contracts	88,000.00	
		88,027.68
July 1, 1900, balance available		7,137.88

Amount (estimated) required for completion of existing project		407,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$200,000.00	
For maintenance of improvement	10,000.00	
		210,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix P P 10.)

11. Removing sunken vessels or craft obstructing or endangering navigation.—(*a*) *Wreck of schooner Benson.*—In June, 1899, the schooner *Benson*, loaded with 800 tons of coal, sunk in Lake Erie near the outer end of channel over outer bar at Sandusky, Ohio.

Efforts were made by owners to remove the schooner and cargo, without success, and in September, 1900, the schooner was abandoned.

The removal of the wreck was therefore authorized under provisions of sections 19 and 20 of the river and harbor act of March 3, 1899, and a contract for its removal at public expense was made. The work was reported as completed May 28, 1900. A complete survey of the location must, however, be made before payment for the work. The survey has been delayed by more important work for the survey steamer and party.

(*b*) *Wreck of schooner Laura Miller.*—In October, 1899, the schooner *Laura Miller*, loaded with coal, sunk in Lake Erie, near the outer end of straight channel through Maumee Bay.

The wreck was so located as to form an obstruction and danger to navigation, and its removal was therefore authorized under provisions of section 19 of the river and harbor act of March 3, 1899.

On the 27th of November, 1899, the wreck was entirely removed. The United States dredge plant was employed for the purpose.

The entire expense of removing this wreck was $639.95.

(*c*) *Wreck of schooner H. G. Cleveland.*—In August, 1899, the schooner *H. G. Cleveland* sunk in Lake Erie, in water 50 feet deep, about 2½ miles from shore and 5¼ miles westward of Cleveland Harbor. The spars, rigging, and other parts were a danger to navigation.

The removal of the wreck was therefore authorized under provisions of section 19 of the river and harbor act of March 3, 1899. A contract was executed for the removal of the wreck to a depth of 35 feet. The work was completed December 18, 1899.

Entire cost of removal was $568.08.

(*d*) *Wreck of schooner Onward.*—The schooner *Onward* was sunk and abandoned in the harbor of Port Clinton, Ohio, in the summer of 1898.

The harbor room being restricted, the wreck was an obstruction, and its removal was therefore authorized under provisions of section 19 of the river and harbor act of March 3, 1899. A contract for the work was executed in January, 1900. The wreck was floated and removed in April, 1900.

The entire cost of removing this wreck was $100

(See Appendix P P 11.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Cleveland Harbor, Ohio, with a view to the further improvement of said harbor: First, by such additional construction or extension as may be necessary to provide a safer and better entrance for vessels at the main entrance to the breakwater in said harbor; second, to provide such additional harbor room as may be found necessary by an extension eastward of the breakwater now under construction in said harbor.*

2. *Sandusky Harbor, Ohio, with a view to obtaining and maintaining a channel 21 feet deep at mean lake level, with a width of 400 feet in the approaches to harbor front and 300 feet in the harbor channels.*

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF CERTAIN RIVERS AND HARBORS IN WESTERN NEW YORK.

This district was in the charge of Maj. Thomas W. Symons, Corps of Engineers. Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

1. *Harbor at Erie, Pa.*—In its original condition the harbor of Erie was landlocked, the only entrance being to the east. The channel was narrow and tortuous, variable in position, with a depth of about 6 feet.

The original project, prepared in 1823, provided for closing the eastern end of the harbor by means of a breakwater in which there should be an opening 200 feet wide, and for extending to deep water in the lake two parallel piers, one on each side of the opening. The project also includes the necessary work of dredging to keep the channel open, making the necessary repairs to existing structures, and maintaining Presque Isle Peninsula.

This project is modified by the river and harbor act of March 3, 1899, and now requires the harbor and entrance to be dredged to a depth of 20 feet, the north and south piers to be extended 500 and 1,000 feet, respectively, and four protection jetties to be built along the outer edge of Presque Isle Peninsula.

The estimated cost of the modified project is $377,000, and $125,000 has been appropriated for beginning work.

At the close of the fiscal year 1,210 feet of wooden superstructure on north pier had been replaced with concrete; the pier had been extended 510 feet; one protection jetty had been built; the channel dredged 20 feet deep, and the basin partly dredged.

The total amount expended on the harbor to June 30, 1899, was $917,086.40.

The maximum draft that could be carried June 30, 1900, over the shoalest part of the locality under improvement was 18 feet.

The following table gives the total arrivals and departures including tonnage for the past ten years, as compiled from Annual Reports of the Chief of Engineers:

Year.	Number.	Tonnage.	Year.	Number.	Tonnage.
1890	2,694	2,480,853	1895	2,936	3,823,672
1891	2,437	2,343,566	1896	3,100	3,634,842
1892	2,180	2,409,945	1897	3,133	4,051,984
1893	1,677	1,701,542	1898	2,939	3,939,019
1894	2,687	3,069,545	1899	3,200	3,961,794

July 1, 1899, balance unexpended	$154,498.72
June 30, 1900, amount expended and repaid during fiscal year	104,185.77
July 1, 1900, balance unexpended	50,312.95
July 1, 1900, amount covered by uncompleted contracts	17,478.22
July 1, 1900, balance available	32,834.73
Amount (estimated) required for completion of existing project	252,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q Q 1.)

2. *Harbor at Dunkirk, N. Y.*—The harbor at Dunkirk is naturally a simple indentation of the south shore of Lake Erie. It lies between Point Gratiot on the west and Battery Point on the east. Between the two points is a distance of 9,600 feet, and the maximum breadth of the bay behind the line of the two headlands is 3,600 feet. The general depth of water in the bay was about 10 feet. The bay is underlaid with rock at an average depth of 15 to 16 feet. The object of the improvement is to form an artificially protected harbor in this indentation or bay.

The original project was adopted in 1827, and, with its subsequent modifications, provided for the construction of a pier running out from the west shore of the indentation and a detached breakwater parallel with the pier, and about 2,000 feet distant from the city front. An opening between the two structures provided a harbor entrance through which a channel leading to the docks was to be deepened to 13 feet.

In 1870 a Board of Engineers recommended a plan which provided for a detached breakwater 2,860 feet long, one part of which, 2,300 feet long, was to be nearly parallel with the shore; the other part, 560 feet long, to be nearly parallel with the axis of the channel entrance. This breakwater and the pier already built were to form the harbor, and the old channel was to be enlarged to 170 feet wide and 13 feet deep.

All the works now existent at Dunkirk have been built according to this plan. The project adopted by Congress and provided for by the river and harbor act of June 3, 1896, consists in completing the breakwater as before planned by the addition of 360 feet to its eastern end and adding the channel arm, 560 feet long, and in addition thereto dredging an entrance channel and a harbor basin, containing in all about 65 acres, to a depth at mean lake level suitable for vessels drawing 16 feet.

The river and harbor act of June 3, 1896, appropriated $10,000 for the work, and authorized the Secretary of War to enter into contract for the whole work at a cost not to exceed $398,258, in addition to the above $10,000. This work was completed in 1898 at a total cost of $389,060.55.

The total amount expended on the harbor to June 30, 1899, was $959,274.05.

The old timber breakwater and pier will soon need repair, to provide for which an estimate is submitted.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the locality under improvement was 17 feet.

The following table gives the total arrivals and departures, including tonnage, for the past ten years, as compiled from Annual Reports of the Chief of Engineers:

Year.	Number.	Tonnage.	Year.	Number.	Tonnage.
1890	100	22,496	1895	69	15,650
1891	96	24,465	1896	42	12,160
1892	58	13,756	1897	197	14,745
1893	137	19,158	1898	180	22,005
1894	76	18,763	1899	192	82,783

July 1, 1899, balance unexpended	$3,063.83
June 30, 1900, amount expended and repaid during fiscal year	1,369.73
July 1, 1900, balance unexpended	1,694.10
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix Q Q 2.)

3. Harbor at Buffalo, N. Y.—Buffalo Creek was the original harbor of the port of Buffalo. In its original condition it was shallow and closed by a gravel bar for most of the year. The original project for the improvement of this harbor was adopted in 1826, and provided at first for the construction of piers on the north and south sides of Buffalo Creek. Subsequently a masonry sea wall, running south from the shore end of the south pier, was proposed and built. In 1868 a detached breakwater about 2,500 feet lakeward from the light-house, to extend south a distance of 4,000 feet, was proposed and adopted. In 1874 it was determined to extend this breakwater to a total length of 7,600 feet. This breakwater has now its full proposed length, the final extension of 806 feet having been built in 1893. It runs parallel with the shore and about half a mile distant from it. In 1874 it was also proposed to build a shore arm to the breakwater, the inshore end to consist of pile near shore and crib work in the deeper water. Upon reaching the 16-foot contour line in the lake this shore arm was planned to continue in a direction making an angle of 45 degrees with the shore and to overlap the south end of the breakwater, leaving an opening of

150 feet. In 1886 a project was approved for replacing with concrete the wooden superstructure as soon as it became badly decayed. To date 3,879.13 feet has been so replaced.

In 1895 a new project was adopted for the improvement of Buffalo Harbor. The project consists of the abandonment of the shore arm, and the extension of the breakwater from its present southern end to Stony Point. The report of the Board and details of its plans are published in the Annual Report of the Chief of Engineers for 1895, page 3153 et seq. The river and harbor act of June 3, 1896, added to the project of the Board of Engineers by providing for the construction of a further length of the sand-catch pier, extending it to the established pierhead line.

The project now in force for the improvement of Buffalo Harbor is:

(1) To maintain existing structures, making the requisite minor repairs, and replacing the wooden superstructure of the breakwater with concrete when necessary.

(2) To build an extension of the breakwater from its present southern end to Stony Point, leaving the necessary openings for the convenience of commerce.

(3) To extend the sand-catch pier to the established pierhead line.

As long as only minor repairs are needed, the cost of maintenance of existing structures is estimated at $2,000 per year. There is a stretch of 1,015 feet of wooden breakwater lying between the two concreted portions, which is now having its superstructure replaced with concrete, a contract for the work having been made. This is the portion of the work which gave the most trouble in building and where the foundation and superstructure are the most insecure.

A new concrete superstructure will be placed on 1,400 feet of the south pier during the present season, the work having been advertised.

The total amount expended by the United States on the improvement of Buffalo Harbor to June 30, 1899, was $3,192,708.42.

A very good harbor has been obtained; the principal features are north and south piers at the mouth of Buffalo Creek, in which most of the business of the port is done; also an outer breakwater 7,608.6 feet long, built of timber and stone, besides the breakwater extension now under way.

A sea wall 5,400 feet long was built along the lake shore south of the harbor entrance, and a sand-catch pier of piles and stone, 1,147 feet long, built out from the shore.

The contractors for the extension of the breakwater and sand-catch pier have at this date finished the sand catch, have partially built 5,000 feet of stone breakwater, have finished the Stony Point section of the timber-crib breakwater, and have nearly completed the south harbor section.

On April 28, 1898, a supplemental contract was made allowing the contractors to procure stone from Canada, which they had contracted to procure from Lockport, N. Y., the United States to receive a rebate of 5 cents per ton on all stone so procured.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the locality under improvement was 20 feet. The commerce of Buffalo is enormous. During the year the arrivals and departures of vessels by lake and river aggregated in number 10,417 and in tonnage 10,481,043.

The arrivals and departures of canal boats by the Erie Canal were

7,506. The principal receipts by lake and river were wheat, corn, flour, oats, iron ore, lumber, copper, pig iron, glucose, lard, and pork. The total receipts amounted to 7,161,166 tons.

The shipments by lake were principally coal, sugar, salt, and cement, and aggregated 3,451,491 tons.

For comparison the following table is given, showing arrivals and departures by lake and canal and the tonnage for the past five years:

Year.	Lake.		Canal.	
	Number.	Tonnage.	Number.	Tonnage.
1895	9,975	9,612,42	9,09	709,346
1896	10,446	11,053,206	11,576	1,570,743
1897	10,778	11,299,091	9,218	1,207,964
1898	10,708	12,040,993	8,338	1,115,407
1899	10,417	10,481,043	7,506	1,083,170

Assuming that the number of arrivals of canal boats equaled the number of clearances, the grand total of the commerce of Buffalo carried on by lake, river, and canal for the seasons of 1898 and 1899 is as follows:

By—	Arrivals and departures.		Receipts of freight.		Shipments of freight.	
	1898.	1899.	1898.	1899.	1898.	1899.
			Tons.	*Tons.*	*Tons.*	*Tons.*
Lake and river	10,708	10,417	8,474,765	7,161,166	3,014,480	3,415,491
Canal	8,338	7,506	350,409	341,736	764,998	691,434
Total	19,046	17,923	8,825,174	7,502,902	3,779,478	4,106,925

July 1, 1899, balance unexpended	$1,176,780.95
June 30, 1900, amount expended during fiscal year	434,197.78
July 1, 1900, balance unexpended	742,583.17
July 1, 1900, amount covered by uncompleted contracts	1,040,913.29
Amount (estimated) required for completion of existing project	743,506.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q Q 3.)

4. *Buffalo entrance to Erie Basin and Black Rock Harbor, New York.*—The first appropriation, $50,000, for this improvement was made March 3, 1899, the item of the act being as follows:

> For improvement of the Buffalo entrance to Erie Basin and Black Rock Harbor, New York, fifty thousand dollars: *Provided,* That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of said project, in accordance with the recommendation of the Secretary of War, House Document Number Seventy-two, Fifty-fifth Congress, first session, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one hundred and ninety-eight thousand one hundred and thirteen dollars and eighty cents, exclusive of the amount herein appropriated.

The adopted project is to build a breakwater about 2,200 feet long, covering and protecting the entrance to Erie Basin and Black Rock Harbor and the lake front of Buffalo Harbor between the State structures known as the Erie Basin Breakwater and the Bird Island Pier.

Contract was made with James B. Donnelly on August 4, 1900, for building the breakwater, and work commenced at once. Under this contract 2,000 feet of cribs have been placed, and the concrete superstructure will be put on this year.

The amount expended to June 30, 1899, was $503.15.

The maximum draft that can be carried over the shoalest part of the locality under improvement is 17 feet.

For commercial statistics see report on Buffalo Harbor.

July 1, 1899, balance unexpended	$49,496.85
Amount appropriated by sundry civil act approved June 6, 1900	191,701.25
	241,198.10
June 30, 1900, amount expended during fiscal year	95,649.39
July 1, 1900, balance unexpended	145,548.71
July 1, 1900, amount covered by uncompleted contracts	119,405.37
July 1, 1900, balance available	26,143.34

(See Appendix Q Q 4.)

5. *Tonawanda Harbor and Niagara River, New York.*—In its original condition the navigation of Niagara River from Lake Erie to Tonawanda was obstructed by several reefs and shoals, which materially limited the draft of vessels traversing it; the water in the harbor between Tonawanda Island and the main shore was shoal, and the river in some places had a very swift current.

The object of the project undertaken is to provide a navigable channel from the head of Niagara River at Lake Erie to the north line of the village of North Tonawanda and to dredge Tonawanda Harbor to a depth permitting its use by vessels of 16 feet draft.

The adopted project of 1888 is to remove obstructions so as to make a channel 400 feet wide and 18 feet deep, which includes work at the following places:

1. On the Horseshoe Reef at the entrance to Niagara River.
2. On the shoal at the head of Strawberry Island.
3. At a few shoal places abreast of the lower end of Rattlesnake Island.
4. The full width of the river between Tonawanda Island and the mainland along the entire front of Tonawanda.

The cost of the work estimated in 1891 was $1,152,987.93. This does not include the work necessary between Tonawanda Island and the north line of the village of North Tonawanda. The amount expended on the general project up to June 30, 1899, was $351,031.58.

At this time the channel through the Horseshoe Reef had been dredged to a depth of 18 feet for a width of 400 feet, and the channel through the reef at Strawberry Island practically completed to a depth of 18 feet and width of 400 feet.

Tonawanda Harbor has been dredged 20 feet wide to a depth of 18 feet along nearly all the length of Tonawanda Island and mainland front, and a shoal at the foot of Tonawanda Island removed.

The commerce of Tonawanda is large. During the year 1899 there were entered and cleared 2,142 lake craft, with a tonnage of 1,128,027 tons. The receipts were principally lumber, iron ore, and limestone, and aggregated 1,151,602 tons. The shipments from Tonawanda amount to very little.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the locality under improvement was 15 feet.

The following table gives the entrances and clearances at Tonawanda for the last three years:

	1897.	1898.	1899.
Vessels entered........number..	1,355	1,137	1,059
Vessels cleared........do....	1,369	1,130	1,059
Entering vessels........tons..	557,748	552,670	564.098
Clearing vessels........do....	553,786	555,091	562,228
Articles received by lake in vessels, rafts, etc........do....	1,240,867	....	1,151,602
Canal clearances........number..	2,735	2,100	....
Shipments by Erie Canal........tons..	502,527	453,998	415,061
Lumber shipments by Erie Canal........feet B. M..	218,576,701	184,709,746	174,294,366

July 1, 1899, balance unexpended	$73,969.42
June 30, 1900, amount expended and repaid during fiscal year	62,640.65
July 1, 1900, balance unexpended	11,328.77
July 1, 1900, amount covered by uncompleted contracts	7,927.58
July 1, 1900, balance available	3,401.19
Amount (estimated) required for completion of existing project	727,987.93
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	164,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q Q 5.)

6. *Niagara River from Tonawanda to Port Day, New York.*—Port Day is the inlet to the old hydraulic-power canal at Niagara Falls. It is not and never has been a practicable port of commerce, owing to shallow water and its proximity to the head of Niagara Falls.

From Port Day up, the river in front of the city of Niagara Falls is very shallow and with rock bed until Conners Island is reached. Between Conners Island and the main shore is a snug little harbor of about 5 acres, with a depth of 12 feet at mean river stage and with a maximum depth of about 18 feet.

By act of Congress of August 18, 1894, provision was made for improving Niagara River from Tonawanda to Port Day, with a view to obtaining a channel of 12 feet depth to Schlosser's dock.

The project as it now stands is, therefore, to provide a channel 12 feet in depth at low water and 200 feet in width from Schlosser's dock back of Conners Island through to Tonawanda by the American Channel of the Niagara River. This project is recognized by the river and harbor act of June 3, 1896. The total cost of the work contemplated by the project is $95,000.

Up to June 30, 1899, there had been expended on the project $44,680.57. A channel 12 feet deep at mean river level and 200 feet wide has been completed the entire length of the Conners Island Shoal, about 1,700 feet, and a channel 12 feet deep and 150 to 170 feet wide through the Cayuga Island Shoal.

The commerce involved in the improvement is very small. During the year the total arrivals and departures were 60, all of which were small excursion boats. Whatever benefit the work confers will be upon future commerce.

The maximum draft that could be carried June 30, 1900, at mean low water, over the shoalest part of the locality under improvement was 12 feet.

July 1, 1899, balance unexpended	$15,319.43
June 30, 1900, amount expended during fiscal year	13,530.29
July 1, 1900, balance unexpended	1,789.14
July 1, 1900, amount covered by uncompleted contracts	1,430.65
July 1, 1900, balance available	358.49
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	26,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix Q Q 6.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. Thomas W. Symons, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. G. L. Gillespie, Corps of Engineers:

1. *Preliminary examination and survey of Dunkirk Harbor, New York.*—Major Symons submitted reports, dated May 3 and October 24, 1899, respectively, with plan for improvement at an estimated cost of $74,827.50. The reports were transmitted to Congress and printed in House Doc. No. 74, Fifty-sixth Congress, first session. (See also Appendix Q Q 7.)

2. *Preliminary examination and survey of Tonawanda Harbor, New York, and Tonawanda Creek from Niagara River to the State dam.*—Major Symons submitted reports, dated May 3 and November 28, 1899, respectively, with plan for improvement at an estimated cost of $27,000, and stated that the work proposed is properly an extension of the general project for improvement of Tonawanda Harbor and Niagara River. In the opinion of the division engineer the existing project should be enlarged to provide for this additional necessary improvement. The reports were transmitted to Congress and printed in House Doc. No. 143, Fifty-sixth Congress, first session. (See also Appendix Q Q 8.)

EXAMINATION OF LAKE ERIE ENTRANCE TO BLACK ROCK HARBOR AND ERIE BASIN, NEW YORK, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Lake Erie entrance to Black Rock Harbor and Erie Basin, New York*, required by the emergency river and harbor act of June 6, 1900, and, if possible, report thereon will be submitted in time for transmission to Congress at its next session.

IMPROVEMENT OF HARBORS ON LAKE ONTARIO AND OF ST. LAWRENCE RIVER AND HARBORS THEREON, NEW YORK.

This district was in the charge of Capt. Graham D. Fitch, Corps of Engineers, to February 13, 1900, in the temporary charge of Maj. Thomas W. Symons, Corps of Engineers, from February 13 to April 26, 1900, and in charge of Captain Fitch since April 26, 1900. Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

1. *Harbor at Wilson, N. Y.*—This harbor is at the mouth of Twelvemile Creek. In its original condition there was a depth on the bar of 1 foot. In 1846 two piers were built by private enterprise about 400 feet into the lake.

The original project of 1873 for improvement by the General Government was to extend the piers to the 12-foot curve in Lake Ontario and to dredge a channel 12 feet deep between the piers and to deep water in the creek, at an estimated cost of $90,000, increased in 1877 to $100,000. January 10, 1900, the project was modified to obtain and maintain a depth of 10 feet at extreme low water, without further extension of the piers, at least for the present.

The amount expended to June 30, 1899, was $70,007.90.

At that date there was a minimum depth of 6.3 feet in a channel width of 60 feet, but the channel is not stable and fills rapidly with sand driven by storms.

With the amount expended during the fiscal year ending June 30, 1900, repairs were made to both piers, and the 60-foot channel was redredged for a length of 1,250 feet to a minimum depth of 9.3 feet below extreme low water.

The following is a statement of commerce at this port for the years given:

	Tons.		Tons.
1890	1,258	1898	294½
1896	1,296½	1899	124

July 1, 1899, balance unexpended	[1]$2,492.60
June 30, 1900, amount expended during fiscal year	1,785.29
July 1, 1900, balance unexpended	707.31
July 1, 1900, outstanding liabilities	440.00
July 1, 1900, balance available	267.31
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix R R 1.)

2. *Harbor at Charlotte, N. Y.*—This harbor is at the mouth of the Genesee River. In its original condition vessels could carry only 8 feet across the bar.

The original project of 1829 was to scour a channel 12 feet deep across the bar by constructing parallel piers to confine and direct the action of spring freshets. The present project of 1882 is to obtain a depth of 15 feet by extending the two piers a total of 3,250 feet and by dredging (see Annual Report of the Chief of Engineers for 1881, p. 2457). After the piers had been extended 1,444 feet the project was modified July 18, 1896, to preserve the depth by dredging without further extension of the piers for the present, and March 2, 1897, it was again modified to obtain and maintain not less than 16 feet and not more than 16½ feet at extreme low water.

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[1] Including $21.49 balance of appropriation of August 11, 1888, which was covered into the Treasury January 22, 1896, and since then not taken up in the money statement.

The amount expended to June 30, 1899, was $521,811.94.

At that date there was a minimum depth of 13.3 feet at extreme low water in a channel width of 150 feet.

During the year the most necessary repairs were made to both piers, and the channel was redredged. The minimum depth now is 15 feet below extreme low water in a channel width of 100 feet.

An allotment of $1,000, from appropriation by emergency river and harbor act of June 6, 1900, was made July 31, 1900, for repairs.

The following is a statement of the commerce at this port during the last ten years:

	Tons.		Tons.
1890	522,957	1895	369,417
1891	480,407	1896	444,557
1892	460,956	1897	385,981
1893	347,288	1898	483,850
1894	400,492	1899	447,428

July 1, 1899, balance unexpended	$6,516.46
June 30, 1900, amount expended during fiscal year	5,958.48
July 1, 1900, balance unexpended	557.98
July 1, 1900, outstanding liabilities	35.25
July 1, 1900, balance available	522.73
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	13,800.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix RR 2.)

3. *Harbor at Pultneyville, N. Y.*—This harbor is in Salmon Creek, Wayne County, N. Y. In its original condition the depth was only 20 inches at its mouth.

The project of 1871–72 was to protect the approach to the creek by building two piers in the lake, of timber cribs filled with stone, and to dredge a channel 10 feet deep from the 10-foot curve in the lake to the mouth of the creek, at an estimated cost of $59,000, increased in 1875 to $71,000 on account of the difficult character of the dredging.

The amount expended to June 30, 1899, was $77,051.77.

At that date there was a governing depth of 0.3 of a foot at extreme low water.

The work done during the fiscal year was the removal of 12,022 cubic yards of sand from a channel 40 feet wide, extending from the 9-foot curve in the lake to the basin in the creek.

Pultneyville is a village of 300 inhabitants with an insignificant commerce.

July 1, 1899, balance unexpended	$1,948.23
June 30, 1900, amount expended during fiscal year	1,211.84
July 1, 1900, balance unexpended	736.39
July 1, 1900, outstanding liabilities	225.00
July 1, 1900, balance available	511.39

(See Appendix R R 3.)

4. *Harbor at Great Sodus Bay, New York.*—In its original condition the channel connecting this bay with Lake Ontario was wide and impracticable for vessels drawing over 8 feet.

The original project of 1829 was to narrow the entrance by constructing two converging breakwaters and deepen it to 12 feet by building two parallel piers and by dredging. The present project of 1882 is to obtain a depth of 15 feet at low water by extending the two piers a total of 1,100 feet and by dredging (see Annual Report of the Chief of Engineers for 1881, p. 2442). After the piers had been extended 519 feet the project was modified July 18, 1896, to restore and maintain the requisite depth of 15 feet by dredging without further extension of the piers for the present.

The amount expended to June 30, 1899, was $478,999.30.

At that date there was a minimum depth of 13 feet at extreme low water in a channel 75 feet wide, and 10.5 feet in a channel 150 feet wide.

During the year repairs were made to the deck and superstructure of both piers, two breaches were closed, and the channel was redredged. The minimum depth now is 13 feet below extreme low water in a channel width of 60 feet.

The following is a statement of commerce at this port for the last ten years:

	Tons.		Tons.
1890	35,619	1895	43,566
1891	36,032	1896	36,361
1892	62,276	1897	53,548
1893	14,277	1898	79,709
1894	77,471	1899	78,885

July 1, 1899, balance unexpended	[1]$10,648.50
June 30, 1900, amount expended during fiscal year	4,038.00
July 1, 1900, balance unexpended	6,610.50
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	9,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix R R 4.)

5. *Harbor at Little Sodus Bay, New York.*—In its original condition the channel connecting this bay with Lake Ontario was about 150 feet wide and 18 inches deep.

The original project of 1854 was to deepen the channel by building two parallel piers across the bar to the 15-foot curve in the lake and to connect them with the shore by riprap. In 1867 this project was modified to provide for dredging to the depth of 12 feet. The present project of 1882 is to obtain a depth of 15 feet by extending the piers to the 15-foot curve in the lake and by dredging (see Annual Report of the Chief of Engineers for 1882, p. 2449). After the piers had been extended 835 feet the project was modified June 29, 1898, to restore and maintain the requisite depth of 15 feet by dredging, without further extension of the piers for the present.

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[1] Including refundment of $1 July 31, 1899.

The amount expended to June 30, 1899, was $335,299.21.

At that date there was a minimum depth at extreme low water of 14 feet in a channel width of 80 feet and 12 feet in a channel width of 150 feet.

No operations were carried on during the fiscal year ending June 30, 1900. The expenditures were for repairing dredging plant, for engineering and incidental expenses, and for payment of outstanding liabilities for repairing piers.

The minimum or governing depth in the channel between the piers is now 13 feet at extreme low water in a channel width of 100 feet.

The following is a statement of the commerce at this port during the last ten years:

	Tons.		Tons.
1890	202,408	1895	63,708
1891	134,241	1896	65,418
1892	101,324	1897	68,888
1893	66,345	1898	50,339
1894	63,595	1899	81,969

July 1, 1899, balance unexpended	[1]$3,143.56
June 30, 1900, amount expended during fiscal year	423.30
July 1, 1900, balance unexpended	2,720.26
July 1, 1900, outstanding liabilities	15.00
July 1, 1900, balance available	2,705.26
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	7,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix R R 5.)

6. *Harbor at Oswego, N. Y.*—In its original condition this harbor, consisting of an inner part in the Oswego River which was navigable by vessels of light draft only and of an outer part forming a cove in the lake, had no protection against the seas.

The original project of 1827 (completed in 1829) was to build across the cove a breakwater of timber cribs filled with stones. Between 1830 and 1838 a superstructure of masonry was built on 500 feet of the breakwater. Between 1866 and 1869 $41,000 was expended in dredging the harbor to the depth of 12 feet at extreme low water. Between 1868 and 1870 the light-house pier was extended north 437 feet. In 1881 there was completed an outer breakwater, having a lake face 4,870 feet long, a westerly shore return 916 feet long, and an easterly return 246 feet long. In 1881 a project was adopted to build an east breakwater, 248 feet of which was constructed in 1881 and removed in 1889. In 1885 and 1889 two spurs to the outer breakwater, 100 and 150 feet long, were completed. In 1893 (sundry civil act of March 3) the excavation of rock in the river was added to the project.

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[1] Including refundment of $1 July 31, 1899.

The present project of 1896, as subsequently modified, is:

First, to build an east breakwater 1,435 feet long, at an estimated cost of $197,000 (acts of March 3, 1895, and June 3, 1896).

Second, to narrow the breach made in the outer breakwater in 1884 from 175 to about 75 feet, at an estimated cost of $18,500 (June 20, 1896).

Third, to carry the rock excavation in the Oswego River farther upstream (March 6, 1897).

Fourth, to remove part of the island between Schuyler and Van Buren streets to a depth of 15 feet; also to excavate rock and dredge to a small extent between the island and the west bank, at an estimated cost of $12,000 (March 6, 1897, and act of March 3, 1899).

The amount expended to June 30, 1899, was $1,908,874.20.

At that date there were 5,857 feet of outer breakwater, also two spurs aggregating 250 feet in length, and 1,963 feet of inner breakwater, forming an outer harbor containing 38.9 acres with a least depth at extreme low water of 14.5 feet, and an inner harbor, including therein the Oswego River, of 9.35 acres with a least depth of 14.5 feet.

June 30, 1900, the harbor areas remained the same as in 1899, the controlling depth being 14½ feet at extreme low water.

The following is a statement of the commerce of this harbor for the last ten years:

	Tons.		Tons.
1890	1,138,144	1895	749,575
1891	826,813	1896	783,972
1892	964,240	1897	706,805
1893	947,688	1898	615,503
1894	829,469	1899	716,753

July 1, 1899, balance unexpended	$53,738.67
June 30, 1900, amount expended during fiscal year	25,333.99
July 1, 1900, balance unexpended	28,404.68
July 1, 1900, outstanding liabilities	1,550.00
July 1, 1900, balance available	26,854.68
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	160,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix R R 6.)

7. *Harbor at Cape Vincent, N. Y.*—This harbor is an open roadstead on the St. Lawrence River, 2½ miles from Lake Ontario, and is a convenient location for vessels to lie during storms at night and in thick weather. In its present unprotected condition, the work of improvement not having advanced sufficiently far, vessels can not moor there with safety.

The original project of 1896 was to build a breakwater parallel to and 600 feet from the railroad wharf, 1,600 feet long, at an estimated cost of $320,000. On May 13, 1899, this project was modified to build a breakwater parallel to and 500 feet from the railroad wharf, 1,500 feet long, at an estimated cost of not over $200,000.

The amount expended to June 30, 1899, was $249.26.

Under contract with Mr. James B. Donnelly, a trench has been dredged to receive 410 linear feet of breakwater, and the filling of the trench with stone begun.

July 1, 1899, balance unexpended		$49,750.74
June 30, 1900, amount expended during fiscal year		605.13
July 1, 1900, balance unexpended		49,145.61
July 1, 1900, outstanding liabilities	$150.00	
July 1, 1900, amount covered by uncompleted contracts	42,000.00	
		42,150.00
July 1, 1900, balance available		6,995.61
Amount (estimated) required for completion of existing project		150,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 7.)

8. *Shoals in the St. Lawrence River between Ogdensburg and the foot of Lake Ontario.*—In its original condition the channel of the St. Lawrence River, from Sister Islands Light down to the head of Brockville Narrows, was obstructed by 12 ledges on which the depth was 9½ feet to 16 feet at low water.

The original project, act of September 19, 1890, was to remove to 18 feet below the zero of the Ogdensburg gauge ledges between Sister Islands and Crossover lights, at an estimated cost of $43,305. In 1893, owing to the discovery of several outlying spurs, the estimated cost was increased to $54,772. By the act of June 3, 1896, the project was extended to embrace ledges in the St. Lawrence between Ogdensburg and the foot of Lake Ontario.

April 13, 1897, the removal of the obstructions to a depth 1.4 feet greater, i. e., to 18 feet below the zero of the Oswego gauge, was included in the project, thereby increasing the total estimated cost to $108,000.

The amount expended to June 30, 1899, was $47,872.78.

At that date two of the ledges had been removed to 18 feet below the zero of the Oswego gauge and 6 to 18 feet below the zero of the Ogdensburg gauge.

Under contract, Pilot Shoal has been removed to 18 feet below the zero of the Oswego gauge.

From correspondence with the collectors of customs at Kingston and Prescott, Canada, and from the commercial statistics compiled in this office, the total commerce which passed over that part of the river under improvement during the calendar year ending December 31, 1899, was 1,295,668 tons.

July 1, 1899, balance unexpended		$20,127.22
June 30, 1900, amount expended during fiscal year		13,104.82
July 1, 1900, balance unexpended		7,022.40
July 1, 1900, outstanding liabilities	$1,266.80	
July 1, 1900, amount covered by uncompleted contracts	4,522.00	
		5,788.80
July 1, 1900, balance available		1,233.60
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 8.)

9. *Harbor at Ogdensburg, N. Y.*—In its original condition the low-water depth in this harbor was 9 feet in the channel leading to the Oswegatchie River, 10 to 12 feet in the two lower entrance channels, and 6 to 12 feet along the city front.

The original project of 1868 was to dredge to the depth of 12 feet and to build, if necessary, 5,500 linear feet of piers, at an estimated cost of $100,000 (see Annual Report of the Chief of Engineers for 1868, p. 271). The piers were never built. The project of 1882 provided for dredging the channel across the shoal to the mouth of the Oswegatchie to 16 feet and all other channels to 15 feet at extreme low water, at an estimated cost of $76,000 (see Annual Report of the Chief of Engineers for 1882, p. 2461). The present project (see Annual Report of the Chief of Engineers for 1890, p. 2872) provided for dredging all the channels to a depth of 16½ feet below the zero of the Ogdensburg gauge (15 feet below the zero of the Oswego gauge), at an estimated cost of $158,950. The project was modified, February 27, 1897, to deepen the two lower entrance channels to 16 feet below the zero of the Oswego gauge, and, by act of March 3, 1899, further modified to dredge the upper 900 feet of the channel along the front of Ogdensburg to but 14 feet below the same zero, elsewhere the projected depths to remain 15 feet.

The amount expended to June 30, 1899, was $282,371.58.

At that date the controlling depth below the zero of the Oswego gauge was: In the two entrance channels 16 feet, in the channel along the city front between the Oswegatchie and the lower harbor 12 feet, and elsewhere 14½ feet.

The work done during the fiscal year ending June 30, 1900, has widened the two lower entrance channels, the basin in front of the Ogdensburg Terminal Company's elevator, the channel between the two lower entrance channels, and the channel along the city front from the middle entrance channel to Elizabeth street.

The controlling depth below the zero of the Oswego gauge is: In the two lower entrance channels and the basin in front of the Ogdensburg Terminal Company's elevator 16 feet, in the channel between the two lower entrance channels 15 feet, in the channel along the city front between the Oswegatchie and the lower harbor 12 feet, and elsewhere 14½ feet.

The following is a statement of the commerce of this harbor during the last ten years:

	Tons.		Tons.
1890	630,281	1895	693,825
1891	699,748	1896	886,438
1892	625,846	1897	866,035
1893	908,048	1898	645,201
1894	736,084	1899	670,363

July 1, 1899, balance unexpended	$14,983.98
June 30, 1900, amount expended during fiscal year	8,176.87
July 1, 1900, balance unexpended	6,807.11
July 1, 1900, outstanding liabilities	3,231.36
July 1, 1900, balance available	3,575.75

Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$7,000.00	
For maintenance of improvement	13,000.00	
		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix R R 9.)

10. Removing sunken vessels or craft obstructing or endangering navigation.—The spars of the schooner *St. Peter*, which sunk in about 100 feet of water off Pultneyville, N. Y., were removed to at least 30 feet below extreme low water, the expense of removal being $179.95. The wreck no longer forms an obstruction to navigation.

(See Appendix R R 10.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. Grasse River, New York, from its confluence with the St. Lawrence River to Massena, with a view to obtaining a depth of 21 feet.

2. St. Lawrence River, at the head of Long Sault Island, with a view of removing the rock obstruction in the South Branch of said river so as to give a navigable depth of 20 feet of water.

PACIFIC COAST.

IMPROVEMENT OF HARBORS IN CALIFORNIA SOUTH OF SAN FRANCISCO.

This district was in the charge of Capt. James J. Meyler, Corps of Engineers. Division Engineer, Col. S. M. Mansfield, Corps of Engineers.

1. San Diego Harbor, California.—San Diego Harbor is just to the northward of the national boundary of Mexico and 482 nautical miles to the southward of San Francisco.

Before the adoption of the present project the work carried on had for its object the preservation of the harbor, which was being injured by the deposit of material brought down the San Diego River during flood stages, and for this purpose a dike was built across the mouth of the river and a new channel excavated, causing the river to empty into False Bay. This work was completed in 1876, at a cost of $79,798.72.

The present project for the improvement of the harbor, approved December 8 and 30, 1890, has for its object the construction of a jetty on Zuninga Shoal at the entrance to the harbor, the maintaining of a channel 24 feet deep at mean low tide and 500 feet wide through the middle ground, and the repairs of the dike. The jetty was to be about 7,500 feet long, extending from Coronado Island out on Zuninga Shoal, with a view to gaining 26 feet at mean low tide on the outer bar, where the survey of 1887 showed a depth of 21 feet.

The original estimated cost of this improvement was $394,400, but, as work on the inner half of the jetty progressed under the different contracts, it became evident that this sum would be inadequate. Therefore, under date of June 20, 1900, the local officer was authorized to change this estimated cost to $542,850.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $290,047.36, and the jetty had been carried a distance of 3,347 feet seaward up to high water, and a foundation course of brush and stone 645 feet farther. The depth of 21 feet had been increased 1½ feet.

During the fiscal year ending June 30, 1900, work was carried on under a contract for the continuation of the construction of the jetty, which was entered into with Healy, Tibbitts & Co., of San Francisco, Cal., on October 16, 1899; time of completion of contract, November 10, 1900. After some months' delay, work was begun April 10, 1900, and up to the close of the fiscal year the contractors had delivered and deposited in place, in foundation course and substructure, 2,543 cubic yards of compressed brush mattresses and 5,613 tons of stone, thus extending the unfinished portion of the jetty 1,033 feet, or to a distance of 5,025 feet from shore. No material results in the way of increased depth or width of channel over the outer bar are as yet apparent from the expenditures made during the past fiscal year, the least depth still being 22½ feet.

The commerce of this harbor was 135,300 tons for the year 1899, this being an increase of about 60 per cent over that of the previous year. One new Atlantic and Pacific steamship line was established during the past year, making two ocean lines now running to this port. The effect on commerce of this work of improvement will be to admit of the entrance of deeper-draft vessels, and to make their passage safer by straightening out the channel.

July 1, 1899, balance unexpended		$67,452.64
June 30, 1900, amount expended during fiscal year		8,686.25
July 1, 1900, balance unexpended		58,766.39
July 1, 1900, outstanding liabilities	$8,721.34	
July 1, 1900, amount covered by uncompleted contracts	46,396.05	
		55,117.39
July 1, 1900, balance available		3,649.00
Amount (estimated) required for completion of existing project		267,850.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		238,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S S 1.)

2. *Deep-water harbor at San Pedro Bay, California.*—The river and harbor act of June 3, 1896, provided for the appointment of a Board to determine upon the location of a deep-water harbor for commerce and refuge in Santa Monica Bay, California, or at San Pedro, in the same State, the decision of a majority of the Board as to location to be final. The Board was to make plans, specifications, and estimates for said improvement. After the Board had rendered its decision and submitted its report the Secretary of War was empowered to make contracts for the completion of the selected harbor in accordance with the project of the Board, at a cost not exceeding in the aggregate $2,900,000.

In accordance with the provisions of this act a Board was appointed, which submitted its report March 1, 1897, deciding in favor of San Pedro Bay. The report of the Board is printed in Senate Doc. No. 18, Fifty-fifth Congress, first session.

On August 12, 1898, a contract was entered into with Messrs. Heldmaier & Neu, of Chicago, Ill., for the construction of the entire breakwater, the price bid by them being $1,303,198.54. The contractors were to commence work on or before November 12, 1898, and they were to so prosecute it as to earn each year the money appropriated by Congress.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $4,202.27, the contractors having deposited in the breakwater but 5,561 tons of stone, the greater part of the time intervening between November 12, 1898, and the end of the fiscal year having been spent by them in the purchase, construction, and installation of plant.

During the fiscal year ending June 30, 1900, Messrs. Heldmaier & Neu demonstrated conclusively their inability to prosecute the work in a sufficiently vigorous manner to attain the rate of progress required by the specifications. Their contract was therefore annulled on March 19, 1900. Up to that date they had delivered and placed, in foundation and substructure, in the west arm of the breakwater 84,581 tons of stone. New bids were solicited by public advertisement dated April 12, 1900, and opened May 14, 1900, six bids in all being received, ranging from $2,360,970.30 to $2,887,065.51. The lowest bid was rejected because of irregularity, and a contract was entered into on June 7, 1900, with the next lowest bidder, the California Construction Company, of San Francisco, Cal., for the completion of the breakwater, their bid being $2,375,546.05. No stone has yet been delivered under this new contract.

The commerce of San Pedro Harbor, heretofore simply an anchorage ground in open roadstead, is so intimately connected with that of Wilmington Harbor that reference is made thereto for statistics on same. The effect on commerce of this work will be to afford a place of refuge, easy of access and secure from storms, for coastwise and deep-draft vessels, and a protected harbor of about 1 square mile in area for the commerce of the latter class of vessels.

The sum of $400,000 was appropriated for this work by the sundry civil act approved July 1, 1898, and $200,000 additional by the sundry civil act approved March 3, 1899.

July 1, 1899, balance unexpended	$609, 942. 39
June 30, 1900, amount expended during fiscal year	47, 335. 16
July 1, 1900, balance unexpended	562, 607. 23
July 1, 1900, amount covered by uncompleted contracts	2, 613, 100. 66
Amount (estimated) required for completion of existing project	2, 050, 493. 43
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	150, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 2.)

3. Wilmington Harbor, California.—Wilmington is situated at the head of a small estuary, which has its outlet in the bay of San Pedro, and is 393 nautical miles to the southward of San Francisco.

Previous to the commencement of the improvement, in 1871, there was a depth of less than 2 feet of water at low tide at the entrance.

The original project, approved July 1, 1871, contemplated gaining a depth of 10 feet at mean low tide by constructing 6,700 linear feet of breakwater of sheet piling and crib work filled with stone, at an estimated cost of $400,000, but, owing to the destruction of part of the structure by storms and other causes, the total cost of this project was increased to $555,000.

In 1881 a further project to increase depth of channel from 10 to 15 feet at mean low tide by dredging a reef and between the jetties, raising existing works, and extending the jetties to 18 feet of water in San Pedro Bay, at an estimated cost of $291,766, was submitted; but on account of smallness of appropriations and consequent delay in prosecuting the work—preventing proper control over currents and other physical conditions—this amount was found to be inadequate, and in 1886 was increased to $400,000.

In 1894 a project was submitted by the local officer in charge for a channel 18 feet deep at mean low tide, which would permit drafts of 22 to 24 feet at high tide, at an estimated cost of $392,725, and, in obedience to a resolution of the United States Senate, the Chief of Engineers submitted this report on February 7, 1895. The river and harbor act of June 3, 1896, appropriated $50,000 for improving the harbor in accordance with this plan, but provided for the appointment of a Board to decide whether a harbor of refuge should be established at Santa Monica or San Pedro (outer harbor of Wilmington), with the condition that if San Pedro were chosen, existing appropriations for the Wilmington Harbor should not be expended. The Board having selected San Pedro, the expenditure of existing appropriations was prohibited, and without further action of Congress the presenting of an estimate for the additional sum required for the completion of the improvement of this harbor was not permissible.

However, the river and harbor act of March 3, 1899, provided for a preliminary examination and survey of the inner harbor, San Pedro, thus designating this work under a new title. The preliminary examination and survey of the harbor were made and reports thereon transmitted to Congress and printed in House Doc. No. 357, Fifty-sixth Congress, first session. They are also submitted as Appendix S S 5 of this report.

Up to the close of the fiscal year ending June 30, 1899, the amount expended on this improvement was $954,209.09, though no work had been done since 1894.

By this expenditure the available channel depth had been increased from 2 feet to 15.5 feet at mean low tide; and as the high tides average nearly 6 feet, vessels drawing over 21 feet could make the entrance.

During the fiscal year ending June 30, 1900, no work has been done on this improvement. The amount expended during the year was for surveys and contingencies. At the close of the year the least channel depth at the entrance was 15.5 feet.

The commerce of this harbor was 239,743 tons for the year 1899, an increase of more than 7 per cent over the year previous. One steamship line was established between this port and San Francisco during the past year.

July 1, 1899, balance unexpended	$50,790.91
June 30, 1900, amount expended during fiscal year	287.67
July 1, 1900, balance unexpended	50,503.24

(See Appendix S S 3.)

4. San Luis Obispo Harbor, California.—San Luis Obispo Harbor is 9 miles to the southward and westward of the town of San Luis Obispo, 216 nautical miles from San Francisco.

It is a bight of the coast about 18 miles long between Point San Luis on the north and Point Sal on the south. The upper end, where Port Harford is situated, has a wharf and is the part used for commercial purposes. Whaler Reef, extending nearly half a mile to the southward and eastward of Point San Luis, forms more or less of a natural breakwater, but during the winter season it is exposed to the heavy swell caused by southerly gales.

The original project, approved September 22, 1888, was to construct a breakwater of rough stone on Whaler Reef, extending from Point San Luis to Whaler Island and thence to a point where the outer reef rises above high water. Its length when completed, including the island, was to be nearly 2,000 feet, and it was to be brought up to the plane of mean low water. The estimated cost was $284,989. This project was subsequently modified January 17, 1893, so as to raise the structure up to a height of 6 feet above high water, with a thickness on top of 20 feet and such side slopes as may be assumed under the action of the sea, at an estimated cost of $568,660.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $172,462.57.

On the above-mentioned date the breakwater had been extended 830 feet from Whaler Island, of which distance 510 feet had been brought up to a height of 6 feet above high water, 280 feet to high water, and 40 feet to mean low water. This made the total length of breakwater, including the island, 1,411 feet, leaving an additional 570 feet to be constructed.

For the expenditure of the $55,000 appropriated by the river and harbor act of March 3, 1899, a contract for the continuation of the construction of the breakwater was entered into on July 29, 1899. Work was begun on August 20, 1899, and it is to be completed by September 30, 1900. Up to the end of the fiscal year the contractor had delivered and placed in the work 12,888 tons of stone, thus extending the unfinished portion of the breakwater 360 feet, or to a total distance of 1,190 feet beyond Whaler Island.

The commerce of this harbor was 51,720 tons for 1899, an increase of 28 per cent over that of the previous year.

July 1, 1899, balance unexpended		$57,537.43
June 30, 1900, amount expended during fiscal year		15,992.77
July 1, 1900, balance unexpended		41,544.66
July 1, 1900, outstanding liabilities	$6,620.01	
July 1, 1900, amount covered by uncompleted contracts	33,184.69	
		39,804.70
July 1, 1900, balance available		1,739.96
Amount (estimated) required for completion of existing project		338,660.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S S 4.)

EXAMINATION AND SURVEY OF INNER HARBOR AT SAN PEDRO (WILMINGTON HARBOR), CAL., MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of the *inner harbor at San Pedro, Cal.*, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. James J. Meyler, Corps of Engineers, and reports thereon, dated March 31, 1899, and January 6, 1900, respectively, were submitted through the Division Engineer, Col. S. M. Mansfield, Corps of Engineers. The plan presented is estimated to cost $2,159,100. In report on preliminary examination the local officer stated that in his opinion the locality was worthy of improvement by the General Government and his views were concurred in by the division engineer; but in forwarding the report on survey, Colonel Mansfield recommends, for reasons given, that the further improvement of Wilmington Harbor be deferred for the present and that only such expenditures be made upon it as will insure it against injury, by replacing with stone the worm-eaten and badly decayed timber work of the east jetty. The reports were transmitted to Congress and printed in House Doc. No. 357, Fifty-sixth Congress, first session. (See also Appendix S S 5.)

EXAMINATION OF COLORADO RIVER, NEVADA, REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examination of *Colorado River, between El Dorado Canyon and Rioville, Nevada, with a view to the extension of navigation to Rioville*, required by the emergency river and harbor act of June 6, 1900, and report thereon will be transmitted to Congress at its next session.

IMPROVEMENT OF ALVISO, SAN FRANCISCO, AND OAKLAND HARBORS, CALIFORNIA, OF SAN JOAQUIN AND SACRAMENTO RIVERS AND THEIR TRIBUTARIES, AND OF RIVERS AND HARBORS IN CALIFORNIA NORTH OF SAN FRANCISCO.

This district was in the charge of Lieut. Col. W. H. Heuer, Corps of Engineers. Division Engineer, Col. S. M. Mansfield, Corps of Engineers, to January 29, 1900.

1. Harbor at Alviso, Cal.—This harbor is a small tidal estuary or slough, and extends from the Bay of San Francisco to the village of

Alviso, Santa Clara County, Cal. A full description of it was published in the Annual Report of the Chief of Engineers for 1897, page 3343.

By the river and harbor act of March 3, 1899, Congress appropriated $48,000 for dredging in the slough, so as to give a low-water depth of 7 feet, with a least bottom width of 60 feet from San Francisco Bay to Alviso. This is the first appropriation made for this work.

No work has yet been done. On September 8, 1899, contract was made for the dredging required by the project. It, however, expired by limitation on April 2, 1900, without any work being done.

A new contract was made May 25, 1900, for dredging the slough, work under which has not yet commenced.

It is thought the funds appropriated will complete the work authorized.

The commerce of the slough is carried on one small steamboat of 295 tons gross tonnage, which makes daily trips, Sundays excepted, between San Francisco and Alviso, and carried 10,920 tons of freight during the year 1899. Scow schooners also carry freight into this slough, but no estimate of their business can be obtained.

The amount expended to June 30, 1899, was $7.82.

July 1, 1899, balance unexpended	$47,992.18
June 30, 1900, amount expended during fiscal year	536.56
July 1, 1900, balance unexpended	47,455.62
July 1, 1900, amount covered by uncompleted contracts	29,930.16
July 1, 1900, balance available	17,525.46

(See Appendix T T 1.)

2. *Harbor at San Francisco, Cal.*—The improvement proposed is the removal of three rocks, known as Arch Rock, Shag Rock No. 1, and Shag Rock No. 2, which are considered a menace to navigation.

The project was adopted by the river and harbor act of March 3, 1899, which provides as follows:

> Improving San Francisco Harbor, California: By removing Arch Rock and Shag Rocks Numbered One and Two, all to a depth of thirty feet below mean low water, according to the report made October thirteenth, eighteen hundred and ninety-seven, one hundred thousand dollars: *Provided,* That the Secretary of War may enter into a contract or contracts for the materials and work necessary for the completion of said project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate five hundred thousand dollars, exclusive of the amount herein appropriated.

Bids for removing the rocks were opened on August 12, 1899, and on September 14, 1899, contract was made for the work for $253,500.

Work was commenced on December 1, 1899, on Shag Rock No. 1, to which all work during the past fiscal year was confined. The contractor fired a few surface blasts and one 3¾-inch hole loaded with giant powder and nitro-gelatin but did no effective work. He then drilled 24 10-inch holes, loaded them with 16,319 pounds of nitro-gelatin, and on April 30, 1900, fired the blast. The rock was well shattered and dredging to remove the broken rock was then proceeded with and continued up to the end of the fiscal year, by which time the rock had been removed to a depth of 27 feet at low water.

July 1, 1899, balance unexpended	$100,000.00
Amount appropriated by sundry civil act approved June 6, 1900	170,000.00
	270,000.00
June 30, 1900, amount expended during fiscal year	3,329.83
July 1, 1900, balance unexpended	266,670.17
July 1, 1900, amount covered by uncompleted contracts	253,250.20
July 1, 1900, balance available	13,419.97

(See Appendix T T 2.)

3. Oakland Harbor, California.—The principal features of this improvement as originally projected are: (1) Two mid-tide training walls of rubblestone extended from the shore westward into San Francisco Bay about 2 miles; (2) a connection, by a canal 1½ miles long, with San Leandro Bay; (3) a dam at the entrance to San Leandro Bay; (4) dredging basin and a channel, the latter to have a depth of 20 feet at low water.

Two modifications were later adopted, namely, to increase width of tidal canal to 400 feet, and to raise the training walls to full tide height.

The original depth of the channel at the entrance to what is now Oakland Harbor was 2 feet at low water.

The total amount appropriated to June 30, 1899, for improving harbor at Oakland, Cal., was $2,270,600; the total amount expended to the same date was $1,919,760.99.

The result of this expenditure was a channel 300 feet wide and 20 feet deep at low water from the Bay of San Francisco to Webster Street Bridge; two stone jetties, one 12,000 feet long and the other 10,000 feet long, built out to San Francisco Bay on the north and south sides of the jetty channel; a tidal basin, about 2 feet deep at low water, covering about 300 acres; a tidal-basin channel in front of Brooklyn, 6 feet deep at low water, 200 feet wide and 5,000 feet long; portions of the tidal canal excavated both at the Oakland and San Leandro ends, and a bridge built over the tidal canal at Park street, between East Oakland and Alameda.

Contracts were made September 27, 1899, for building a drawbridge across the tidal canal at High street, Alameda, Cal.; January 16, 1900, for building a diverting channel for Sausal Creek to prevent deposits in the tidal canal; and March 6, 1900, for building a drawbridge across the tidal canal at Fruitvale avenue, near Alameda, Cal. These works are still in progress, and consequently no changes have resulted during the fiscal year.

The sundry civil act of June 6, 1900, appropriated $180,000 for continuing this work, making the total amount thus far appropriated $2,450,600 and completing the appropriation of $666,000, to which extent Congress, by act of June 3, 1896, authorized continuous contracts. Of the items in the project adopted by Congress, the bridge across the tidal canal at Washington avenue remains to be built or provided for and the tidal canal to be dredged. The amount available, viz, $391,869.14, is believed to be sufficient for the purpose.

July 1, 1899, balance unexpended	$350,839.01
Amount appropriated by sundry civil act approved June 6, 1900	180,000.00
	530,839.01
June 30, 1900, amount expended during fiscal year	25,164.99
July 1, 1900, balance unexpended	505,674.02
July 1, 1900, amount covered by uncompleted contracts	113,804.88
July 1, 1900, balance available	391,869.14

(See Appendix T T 3.)

4. *San Joaquin River, California.*—Before improvement the low-water channel to Stockton was only 6 feet in depth and contained several sharp bends where navigation was difficult, while the upper river, above Stockton, was navigable for but few months in the year, during the high-water stage, and part of that time for boats drawing not more than 2 feet of water.

The plan for improvement adopted in 1877, and slightly modified in 1881 and 1888, had for its object the securing and maintaining, by dredging, of a channel 9 feet deep at low water and 100 feet wide through the tidal portions of the river and Stockton Channel to Stockton, and a channel in Mormon Slough 4 feet deep at low water and 80 feet wide to Miller's warehouse; also temporary improvement of the low-water channel of the upper river by dredging, scraping, removal of snags, and the closure of Paradise Cut and Laird Slough.

The amount expended on the improvement of this river to June 30, 1899, was $389,339.38.

The results obtained to June 30, 1899, were the maintenance of a low-water channel 9 feet in depth to Stockton, which is the result of the dredging which has been carried on every year since 1877; the shortening of the river 4½ miles by cut-offs which have been made, three of which are near Devils Elbow, one at Head Reach, and a double cut-off in the narrows below Stockton; a double cut-off at Twenty-one Mile Slough, and the improvement of the navigation of the upper river by the removal of snags and the partial closure of Laird Slough and Paradise Cut by dams.

The work done during the past fiscal year has been dredging in Stockton and Mormon channels. In July, 1899, a shoal which had formed in Stockton Channel was removed, and on October 9, 1899, contract was made to redredge Stockton and Mormon channels to the head of navigation. This work was in progress at the end of the fiscal year, but it is thought will be completed by the end of August, 1900. The depths and widths required by the approved project have been maintained and navigation to Stockton has been uninterrupted, but owing to the drought there was no navigation on the upper river during 1899.

The commerce on the lower San Joaquin River (below Stockton) is large and important. It is carried on 13 steamers, averaging 550 tons each; 14 barges, averaging at least 100 tons each, and many scow schooners. During 1899 it amounted to 270,013 tons of freight and 133,832 passengers, which were all carried on the lower river.

The maximum draft that can be carried to Stockton at mean low water is 9 feet.

The amount required for completion of the existing project is indeterminate.

July 1, 1899, balance unexpended	$62,160.62
June 30, 1900, amount expended during fiscal year	18,040.16
July 1, 1900, balance unexpended	44,120.46
July 1, 1900, amount covered by uncompleted contracts	8,000.00
July 1, 1900, balance available	36,120.46

(See Appendix T T 4.)

5. *Mokelumne River, California.*—This river, a tributary of the San Joaquin, is a tidal stream, and is navigable to New Hope Landing, 13 miles above its mouth.

Originally navigation was difficult on account of overhanging trees, numerous snags, and a shoal opposite New Hope Landing.

In 1884 project was made to remove snags and overhanging trees, and in 1892 to dredge shoal and remove point of land opposite New Hope Landing. Appropriations aggregating $18,000 were made in 1884, 1886, 1888, 1892, and 1894, and up to date $17,111.66 has been expended as appropriations became available, in accordance with the project, which has been completed.

The commerce of the river is handled by one steamer of 385 tons capacity and a few scow schooners. The total tonnage carried in 1898 is reported as 51,614.

There has been no improvement in the depth of the stream. It has been widened by the removal of overhanging trees, and there is now no obstacle to navigation for such craft as use this river. The amount of commerce varies with the crops grown. Practically all that grows on and near the banks of the river is transported by the water route.

No work has been done on the river since 1896, and none is required until other snags shall lodge in the river. No deterioration of channel has been reported since work was completed in 1896, and it is not known that the work done has increased the tonnage of the river. The maximum draft that can be carried at mean low water is fully 3 feet.

July 1, 1899, balance unexpended	$888.34
July 1, 1900, balance unexpended	888.34

(See Appendix T T 5.)

6. *Sacramento and Feather rivers, California.*—Before improvement navigation on these streams was difficult and dangerous above Sacramento on account of snags, shoals, and rapids. Below Sacramento the river was deep and navigation easy. Since that time the river bed from the mouth of the Feather down has been in places badly filled up with mining débris.

In 1874 a project was adopted having for its object the improvement of the low-water channels of the Upper Sacramento and the Feather rivers by removing snags, scraping bars, and the construction of temporary wing dams. No attempt at permanent improvement was contemplated. In 1890 the project was increased to include the closure of Paines Break, a crevasse about 1¾ miles below the city of Sacramento. In 1892 it was again increased to include the closure of Jacob Slough, a crevasse above the city of Sacramento; the treatment of the Yuba River near and above Marysville, a locality in which an enormous amount of mining débris had been deposited, and the removal of obstructions in the Lower Sacramento River. In 1899 the Board of Engineer Officers appointed in pursuance of the river and harbor act of June 3, 1896, made a project for increasing the navigable depth of the Sacramento River below Sacramento by means of a series of wing dams.

The work done under this project is treated in the report for improving Sacramento River, California.

The amount expended on these rivers to June 30, 1899, was $725,838.83.

The work to June 30, 1899, resulted in a low-water channel with a least depth of 7 feet from Suisun Bay to Sacramento, 4 feet from Sacramento to Butte City, 3 feet from Butte City to Tehama, and 2½ feet from Tehama to Red Bluff.

The work during the past fiscal year consisted of operations of the U. S. snag boat *Seizer*, which was at work from July 24, 1899, until January 3, 1900, removing snags and building wing dams, by which the depths above noted were maintained and commerce was uninterrupted.

The commerce on the upper river, including the Feather, is carried on six steamers, averaging 133 tons, and eight barges, averaging 600 tons. On the lower river the commerce is carried on nine steamers, averaging 408 tons, and twenty-two barges, averaging 600 tons.

The total freight carried on the Sacramento River during 1899 was 484,806 tons, and on the Feather River 4,430 tons.

The maximum draft that could be carried on June 30, 1900, on the Sacramento River was, from Suisun Bay to Sacramento, 8 feet; thence to Butte City, 5 feet; thence to Tehama, 3½ feet, and thence to Red Bluff, the head of navigation, 3 feet, the river not having at that date reached its low-water stage.

The amount required for the completion of the existing project is indeterminate.

In addition to the balance available and to amounts appropriated for work below Sacramento funds will be required to operate the snag boat, so as to keep navigation open on the upper river to June 30, 1902.

The general improvement of these rivers is under the charge of a Board of Engineer Officers, appointed in pursuance of the river and harbor act of June 3, 1896, which has made a project for the improvement of the river from Sacramento down (see Appendix T T 7 herewith). For this reason no estimate other than the cost of running the snag boat to June 30, 1902, is presented.

July 1, 1899, balance unexpended[1]	$34,161.17
June 30, 1900, amount expended during fiscal year	20,022.38
July 1, 1900, balance unexpended	14,138.79
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	18,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T T 6.)

7. *Sacramento River, California.*—The river and harbor act of March 3, 1899, contained the following clause:

> Improving Sacramento River, California, from the city of Sacramento to the mouth: Continuing improvement, thirty thousand dollars: *Provided*, That a contract or contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry out the revised project printed in House Document Number One hundred and eighty-six, Fifty-fifth Congress, second session, and House Document Number Forty-eight, Fifty-fifth Congress, third session, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate the sum of two hundred and fifty thousand dollars, exclusive of amount herein and heretofore appropriated. * * *

In 1899 project was made and approved for a series of wing dams opposite the city of Sacramento, extending as far out into the stream and of such number as might be found necessary to deepen the shoal water which extended along and below the city front. Under this project contract was made on September 1, 1899, for building the dams. Work was commenced October 2, and suspended November 18, 1899, on account of high water. By this time three dams had been completed and a fourth partially so. It is thought work can be resumed about August 1, 1900.

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[1] In the Annual Report of the Chief of Engineers for 1899 the balance unexpended for improving Sacramento and Feather rivers, California, was given as $64,161.17. This included $30,000 appropriated by act of March 3, 1899, for improving Sacramento River, California, which has since been carried to a separate account for that work (see Appendix T T 7 herewith).

As the river was still at a high stage at the end of the fiscal year, no survey had been made to determine the results of the work.

An additional $60,000 was appropriated by the act of June 6, 1900.

The amount of freight carried on the Lower Sacramento River during the year 1899 was 460,475 tons. The maximum draft that could be carried from the mouth of the river to Sacramento on June 30, 1900, was 8 feet, the river at that date not having reached its low stage.

This improvement is under the direction of a Board of Engineer Officers, constituted by S. O., No. 18, Headquarters, Corps of Engineers, July 27, 1896, as authorized by the river and harbor act of June 3, 1896, in whose report in Appendix T T 7 reference to future work is made.

July 1, 1899, balance unexpended	$30,000.00
Amount appropriated by sundry civil act approved June 6, 1900	60,000.00
	90,000.00
June 30, 1900, amount expended during fiscal year	2,343.36
July 1, 1900, balance unexpended	87,656.64
July 1, 1900, amount covered by uncompleted contracts	27,656.64
July 1, 1900, balance available	60,000.00

(See Appendix T T 7.)

8. *Napa River, California.*—Napa River before improvement had an average low-water depth of 5 feet, with the exception of the bars, where the depth was reduced to less than 1 foot on the crests. The ordinary rise of the tides being 5 feet there was each day a practicable depth of 6 feet.

The approved project consists in dredging the bars between Carr Bend and Vernon Mills, in the immediate vicinity of Napa City, cutting off projecting points of land so as to obtain a channel 75 feet wide and 4 feet deep at mean low water, and removing obstructions, such as snags, logs, etc.

Work upon this improvement was commenced in 1889, and in that year a channel was dredged through the different bars between Carr Bend and the highway bridge at Third street, Napa City, and the river was cleared of snags. The channel was again dredged in 1891.

Up to June 30, 1899, $21,428.42 had been expended on this improvement, the result being that the width and depth of the channel had been generally maintained and all dangerous snags, logs, etc., had been removed from the channel.

During the past fiscal year $26.67 had been spent in making contract to dredge shoals which had re-formed, but no work has been done on the river. Navigation has been uninterrupted. The contract to redredge the shoals was made on June 30, 1900, and work under it will be done early in the coming fiscal year.

The commerce of the stream is increasing; the amount reported as carried during 1899 was 160,495 tons.

This channel, being a tidal portion of a silt-bearing stream, requires occasional dredging. The amount required for the completion of the project is consequently indeterminate.

The maximum draft that can be carried to the town of Napa, the head of navigation, is 6 feet at high water. Until the shoal which has formed just below the town is dredged the maximum draft that can be carried at mean low water is less than 1 foot.

July 1, 1899, balance unexpended	$4,071.58
June 30, 1900, amount expended during fiscal year	26.67
July 1, 1900, balance unexpended	4,044.91
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T T 8.)

9. *Petaluma Creek, California.*—This creek is an estuary of San Pablo Bay, and is navigable for 16 miles of its length to Petaluma, a town of about 4,000 inhabitants, which is the head of navigation.

Before improvement it was very crooked, dry in places at low water, and navigation was dependent entirely upon the tide.

In 1880 project was made for straightening the stream by making cut-offs and dredging to obtain a channel 50 feet wide and 3 feet deep at low tide. In 1892 the project was extended to dredge the channel as deep as funds would permit.

Up to June 30, 1899, $60,968.04 had been expended on this improvement, with the result that the creek had been shortened 2.5 miles, and a channel dredged having a least width of 50 feet, and a least depth of 4 feet near the town of Petaluma, and of 6 feet in the lower portion, at mean low stages of tide.

During the past year the creek, having shoaled somewhat, was redredged under contract. This maintained the channel width and depth as projected.

The maximum draft that can be carried to Petaluma, the head of navigation, is 4 feet at mean low water.

The commerce of this creek, which is valuable and important, is carried on one steamboat (294 tons), and numerous scow schooners which carry the heavier freight. The tonnage during 1899 was large, but as much of it was carried on the scow schooners it can not be reliably stated.

The drainage area of this stream is about 83 square miles of land, principally agricultural; consequently large quantities of detritus are annually carried into the channel which the tide waters are unable to carry out; hence redredging will be required about every two years to maintain navigation.

July 1, 1899, balance unexpended	$4,031.96
June 30, 1900, amount expended during fiscal year	3,718.93
July 1, 1900, balance unexpended	313.03
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix T T 9.)

10. Humboldt Harbor and Bay, California.—Before improvement the harbor was obstructed by a troublesome and variable sand bar, inclosing the entrance about a mile distant. Across the submerged bar was a channel which was exceedingly shifting, uncertain, and dangerous; its low-water depth has been occasionally as much as 25 feet, and frequently as little as 9 feet. The bar constantly changed in position, the greatest range being about 1½ miles. Vessels were often storm bound in the harbor for long periods. There were also numerous shoals within the harbor, close to the wharves, rendering it difficult for vessels to reach Eureka, Arcata, and Hookton, the main shipping points on the bay.

In 1881 a project for improving the inner harbor was adopted, with a view to securing, by dredging, a channel 12 feet deep and 100 feet wide to the head of Eureka wharves, and one 10 feet deep and 100 feet wide to Arcata and Hookton. This project was completed in 1884 at a cost of $80,884.69. These channels have since silted up materially. By the river and harbor act of March 3, 1899, an appropriation of $50,000 was made for dredging in the inner harbor.

In 1882 a project was adopted for improving the entrance, with the object of increasing the depth of water over the bar, by constructing a low-tide brush and stone jetty, extending seaward from the end of the south spit for a distance of 6,000 feet. Its estimated cost was $600,000. In 1891 a Board of Engineer Officers recommended the raising of this jetty to high tide, and the addition of another, making two stone and brush jetties, nearly parallel, about 2,100 feet apart, starting from the north and south spits, respectively, and extending seaward to the 18-foot contour, with such groins as might be found necessary during the progress of the work. The north jetty was not to be begun until the completion of the south. The total cost of these jetties and the necessary bank protection was estimated at $1,715,115, in addition to the sum which had already been appropriated. In 1892 the project was slightly modified so as to start the north jetty from the end of the dike already built for shore protection, making that a part of the jetty. The construction of the north jetty, so far as thought necessary to prevent erosion, without waiting for the completion of the south jetty, was also authorized. The river and harbor act of July 13, 1892, placed the improvement under the continuing-contract system.

The amount expended on this work to June 30, 1899, was $1,991,097.16, of which $80,985.47 was for dredging in the inner harbor, and the sum of $1,910,111.69 for improving the entrance.

The result accomplished by the work done to June 30, 1899, was a 24-foot channel, 1,350 feet wide, across the bar between the jetties, both of which had been extended to their full length, but required some additional rock to complete them to their full height. The channels dredged inside the harbor had deteriorated by shoaling, but on June 30, 1899, a contract to dredge the inner harbor had been made.

During the past fiscal year $180,745.38 was expended on this work, of which $130,846.16 was spent on the jetty work at the entrance to the harbor, and $49,899.22 in dredging the inner harbor. Both portions of the work were completed during the year.

The work done on the jetties during the past fiscal year, which completed them, was placing 26,179 tons of rock in the south jetty, and 8,733 tons in the north. The contract was completed on August 30,

1899. At the time of the completion of the jetties, when their crests were well above high-water level and the whole current effect was concentrated over the bar, the least channel depth of water anywhere between the bay and the bar was 28 feet at low water, but as the crests become lowered by sea action it is probable this may be somewhat reduced. The channel width remained at 1,350 feet.

The dredging which was commenced on August 9, 1899, and completed on March 2, 1900, gave a channel, which extends 8,900 feet along the front of the town of Eureka, 200 feet wide and 15 feet deep at low water.

During the year 1899, 1,300 vessels, having a gross tonnage of 527,369 tons, passed over Humboldt bar, but large and important as this traffic is, the improvements made are believed to have provided a harbor in every way adequate to the demands of the commerce of the port.

July 1, 1899, balance unexpended	$196,517.84
June 30, 1900, amount expended during fiscal year	180,745.38
July 1, 1900, balance unexpended	15,772.46

(See Appendix T T 10.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, Maj. (now Lieut. Col.) W. H. Heuer, Corps of Engineers, and reports thereon submitted through the Division Engineer, Col. S. M. Mansfield, Corps of Engineers:

1. Preliminary examination of harbor of South San Francisco, Cal.—Major Heuer submitted report June 9, 1899. In his opinion the locality is not worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The report was transmitted to Congress and printed in House Doc. No. 101, Fifty-sixth Congress, first session. (See also Appendix T T 11.)

2. Preliminary examination of Suisun Creek, California.—Major Heuer submitted report June 19, 1899. It is his opinion, concurred in by the division engineer and by me, that the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 49, Fifty-sixth Congress, first session. (See also Appendix T T 12.)

3. Preliminary examination and plan and estimate for improvement of Napa River, California.—Major Heuer submitted reports dated March 29 and July 20, 1899, respectively, with plan for improvement at an estimated cost of $3,600. In his opinion, concurred in by the division engineer and by me, the locality is worthy of improvement by the General Government. The reports were transmitted to Congress and printed in House Doc. No. 48, Fifty-six Congress, first session. (See also Appendix T T 13.)

4. Preliminary examination of Sonoma Creek, California.—Major Heuer submitted report May 3, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 47, Fifty-sixth Congress, first session. (See also Appendix T T 14.)

5. *Preliminary examination and plan and estimate for improvement of channel between Straits of Karquines and the Golden Gate, California, off Point Pinole, Point Wilson, and Lone Tree Point.*—Major Heuer submitted reports dated March 29 and September 6, 1899, respectively, with plan for improvement at an estimated cost of $381,000 and $16,000 per annum for maintenance. The locality is considered by the local officer to be worthy of improvement by the General Government, and his views are concurred in by the division engineer and by me. The reports were transmitted to Congress and printed in House Doc. No. 89, Fifty-sixth Congress, first session. (See also Appendix T T 15.)

6. *Preliminary examination of Crescent Bay (Crescent City Harbor), California.*—Major Heuer submitted report July 18, 1899. In his opinion, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 73, Fifty-sixth Congress, first session. (See also Appendix T T 16.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *San Joaquin River, California, above the mouth of the Stanislaus River, with a view of determining the advisability of closing the mouths of the more important blind sloughs leading from said San Joaquin River and tributaries, especially those known as Finegan, Amphlet, and Walden sloughs, that the water in the main channel of the said San Joaquin River may be retained therein and more effectually promote navigation thereof.*

2. *The San Joaquin River and the waterways connecting the same with the Straits of Karquines, extending from the town of Antioch to Suisun Point.*

3. *Oakland Harbor, California, with a view to the improvement of said harbor, to meet the needs of present and prospective commerce, from the western end of the tidal canal to deep water in San Francisco Bay, including the excavation of a tidal basin.*

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN OREGON, OF UPPER COLUMBIA AND SNAKE RIVERS, OREGON AND WASHINGTON, AND OF CLEARWATER RIVER, IDAHO.

This district was in the charge of Capt. William W. Harts, Corps of Engineers. Division Engineer, Col. S. M. Mansfield, Corps of Engineers.

1. *Port Orford Harbor, Oregon.*—The river and harbor act of August 18, 1894, provided for a survey of—

> Port Orford, with a view to improving the same for shipping purposes and as a harbor of refuge, commencing at Grave Yard Point and by jetty, sea wall, or other proper construction extending southerly or southeasterly into the ocean three hun-

> dred or more feet, if necessary, and suitable for vessels of middle draft; and, secondly, if necessary, by another jetty, sea wall, or other constructive work, extending from the next high point or headland southwesterly four hundred or more feet, so as to accommodate vessels of maximum draft.

The report (Annual Report of the Chief of Engineers for 1895, pp. 3491–3501) submitted in compliance with the above-quoted item stated that—

> Port Orford is an open roadstead and village on the coast of Oregon, 51½ miles north of the California and Oregon boundary line,

and that—

> An inspection of the maps shows that Port Orford is wide open to the sea to the southward, the direction from which come the worst storms, and that the constructions as located are nearly head on to the sea and do not provide any inclosed anchorage area. This being the case, it is certain that they do not and can not be considered as providing in the remotest degree a "harbor of refuge." Therefore this view of the proposed improvements must be entirely cast aside, and they must be considered solely in relation to their use for "shipping purposes," as mentioned in the law.
>
> These constructions for "shipping purposes" are therefore construed to be piers or wharves, and the estimate herewith is for their construction as wharves for commercial shipping purposes.
>
> It is also proper to add that the wharves can be used with regularity only during the summer season and when northerly weather prevails. They can not be used during the prevalence of heavy, southerly, winter weather. For the same reasons the wharves must be built during the summer months.
>
> The only way that a harbor of refuge can be constructed at Port Orford is by building a breakwater approximately on the lines laid down by the engineers and Boards of Engineers who have had the matter under consideration.

The report contained an estimate of $203,366 for constructing a wharf from Grave Yard Point; also an estimate for constructing the wharf from Nellys Point, "the next high point or headland southwesterly." Pursuant to this report the river and harbor act of June 3, 1896, contained the following item:

> Improving Port Orford Harbor, at Grave Yard Point, Oregon, according to plan recommended by Capt. Thomas W. Symons, of the Corps of Engineers, as per House Document Numbered Three hundred and thirteen, Fifty-third Congress, third session, January thirtieth, eighteen hundred and ninety-five, to cost not to exceed two hundred and three thousand three hundred and thirty-six dollars, and the unexpended balance of the appropriation heretofore made March third, eighteen hundred and seventy-nine, for the establishment of a harbor of refuge on the Pacific coast is hereby transferred to be expended on this improvement, if in the opinion of the Secretary of War the interests of commerce demand such expenditure.

The same act also provided for a survey of Port Orford Harbor, Oregon, with estimate of cost of the improvement and its importance to shipping and commerce. The report submitted in compliance with the last-named provision, printed in the Annual Report of the Chief of Engineers for 1898, pages 3003–3006, was to the effect that the present shipping and commercial importance of Port Orford is utterly insignificant when considered in connection with the enormous sum required to adequately protect the harbor from storms, estimated by a Board of Engineers, in report of November 19, 1890, to be $7,821,960.

The item in the act of June 3, 1896, making appropriation for the improvement of Port Orford Harbor, by rendering available the unexpended balance of the appropriation of March 3, 1879, for the establishment of a harbor of refuge on the Pacific Coast, contains the provision "if in the opinion of the Secretary of War the interests of commerce demand such expenditure."

The Secretary of War having decided, January 27, 1900, that the benefit that would be derived from the proposed wharf would not be commensurate with the expenditure necessary for its construction, the officer to whom the duties connected with the proposed improvement were assigned was directed to discontinue further consideration of the subject.

A history of the examinations, surveys, and reports upon the subject of the proposed improvement of Port Orford Harbor up to 1891 (since which time there has been but little change in conditions) is given in the Annual Report of the Chief of Engineers for 1891, pages 3305–3312.

Commercial statistics (calendar year).

	Tons.		Tons.
1894	329	1897	892
1895	627	1898	532
1896	852	1899	702

July 1, 1899, balance unexpended	$140, 858. 52
July 1, 1900, balance unexpended	140, 858. 52
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	62, 477. 48

(See Appendix U U 1.)

2. *Coquille River, Oregon (general improvement).*—This stream empties into the Pacific Ocean at Bandon, Coos County, Oreg., about 375 miles north of San Francisco. Once safely across the bar in the ocean at the mouth of the river vessels drawing 11 feet of water experience no special difficulty in ascending the stream at high tide to the town of Coquille, 25 miles above Bandon.

Before improvement the channel at the mouth of the river skirted the south headland for some distance, as shown on the map opposite page 2682 of the Annual Report of the Chief of Engineers for 1882, and was tortuous, shoal, shifting, and studded with the dangerous rocks, shown in photograph No. 3 opposite page 3200 of the Annual Report of the Chief of Engineers for 1899. The depth of the water on the bar at the old mouth of the river was about 3 feet at low tide, or a little over 7 feet at high tide.

The original plan for improvement (report printed in the Annual Report of the Chief of Engineers for 1879, p. 1806) provided for the construction of two converging high-tide rubblestone jetties 800 feet apart, to confine and control the incoming and outgoing waters so as to cause them to scour a channel through the sand spit then on the north side of the entrance, the jetties to run out to sea a sufficient distance to create and maintain a channel, running straight out to sea, 12 feet deep at low tide. Estimated cost, $164,200.

The law of August 11, 1888, and the law of September 19, 1890, in making appropriations for continuing the work of improvement at the entrance to the river, authorized the expenditure of $5,000 and $3,000, respectively, in removing snags in the 13 miles of the upper portion of the river between Coquille and Myrtle Point, and $6,883.90 was so expended.

In 1880 the proposed depth of 12 feet at low tide to be obtained in the new channel at the entrance to the river was reduced to 10 feet; in 1888 it was reduced to 8 feet, and in 1891 the plan was changed to provide that the jetties should be 600 feet apart at their outer ends, instead of 800 feet.

In 1892 the estimate of cost for completing the improvement, including previous appropriations (and including the $6,883.90 expended in removing snags in the river between Coquille and Myrtle Point under the acts of Congress of August 11, 1888, and September 19, 1890), was increased from $164,200 to $285,000. (Annual Report of the Chief of Engineers for 1892, pp. 2664–65.)

The method finally adopted as the one most satisfactory and successful for constructing the jetties consists of building a double-track tramway resting on piles driven into the bed of the ocean along the line of each proposed jetty, upon which is hauled, in dump cars pulled by a small locomotive, the rubblestone to be dumped in place in the jetty below. A portion of the double-track tramway over the south jetty is shown in photograph No. 2, page 3200, Annual Report of the Chief of Engineers for 1899.

The amount expended to June 30, 1899, including the $6,883.90 expended in removing snags in the upper portion of the river, was $169,836.44, and resulted in the construction of the south jetty tramway and the south jetty itself for the distance of 2,387 feet, and in the construction of the north jetty for the distance of 510 feet. This work resulted in closing up the dangerous old channel that skirted the south headland and in securing a new channel running straight out to sea a considerable distance north of the old channel, the depth obtained in the new channel ranging from 4 to 10 feet at low tide. The position of the new channel and the manner in which the old channel has been filled up with sand and débris by the effect of the jetties are shown on map opposite page 3324 of the Annual Report of the Chief of Engineers for 1893. While the depth obtained in the new channel up to June 30, 1899, was not much greater than the depth that existed in the old channel, the effect the incomplete jetties produced in providing a new, straight channel, free from the dangers of the old channel, was alone a considerable improvement.

The amount expended during the fiscal year ending June 30, 1900, was for a survey of the channel at the new entrance to the river, and for completing the south jetty, under a contract dated August 15, 1899, by extending it seaward 315 feet, making its total length about 2,700 feet.

This has resulted in maintaining the new entrance channel running straight out to sea, without obtaining any appreciable increased depth.

It is estimated that with the funds available June 30, 1900, the crest of the old incomplete north jetty, which has been considerably beaten down by heavy seas throughout its length of 510 feet, may be built up to its projected height for the distance of about 400 feet. It is not expected that an increased depth will occur until the north jetty has been extended farther seaward.

During the fiscal year ending June 30, 1900, the maximum draft that could be carried over the ocean bar at the new entrance to the river ranged from 3 to 15½ feet at mean low tide, the average being about 6 feet.

On account of the conditions surrounding the work of constructing the jetties at the entrance to Coquille River it would be much more economical if funds for carrying on the work could be provided by Congress in installments of at least $50,000 each. The appropriation of March 3, 1899, $40,000, was the largest ever made for the work. Prior to that appropriation nine appropriations were made, aggregating $170,000, or an average of less than $19,000 each. If the north jetty is to be completed within the estimated cost, it will be necessary that the appropriations be larger and thus make it possible to prolong the periods of active operations, which, in turn, will render it possible to dispense with some of the expense that has been incurred in past years in making repairs to the tramways, etc., rendered necessary by reason of natural decay, the ravages of the teredo, and the heavy seas.

The principal articles of commerce carried over the bar at the entrance to the river are lumber and coal. This commerce is loaded on small coasting vessels along the 25 miles of the river between its mouth and Coquille and by them taken to San Francisco. Considerable coal, a valuable and scarce commodity on the Pacific Coast, is found on Coquille River about 15 miles above its mouth.

Commercial statistics.

	Tons.		Tons.
1879	7,000	1891	15,994
1882	6,630	1892	19,362
1883	9,438	1893	14,491
1884	13,100	1894	14,180
1885	7,649	1895	16,256
1886	9,080	1896	21,106
1887	6,631	1897	25,620
1888	29,197	1898	24,556
1889	29,309	1899	26,654
1890	23,223		

NOTE.—The statistics for 1895–1899, inclusive, are for calendar years; those for years prior to 1895 for fiscal years ending June 30. Statistics for years not named are not available.

July 1, 1899, balance unexpended		$40,163.56
June 30, 1900, amount expended during fiscal year		14,458.23
July 1, 1900, balance unexpended		25,705.33
July 1, 1900, outstanding liabilities	$3,652.77	
July 1, 1900, amount covered by uncompleted contracts	19,398.69	
		23,051.46
July 1, 1900, balance available		2,653.87

Amount (estimated) required for completion of existing project	75,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	65,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix U U 2.)

3. *Coquille River, Oregon, between Coquille and Myrtle Point.*—The Coquille River enters the Pacific Ocean in the southwestern part of Oregon. It is formed by four small forks, which, coming from the Coast Range of mountains, unite in the vicinity of the town of Myrtle Point. It is a tidal river, navigated by small coasting vessels from its mouth in the Pacific Ocean up to Coquille, a distance of about 25 miles, and, when there is sufficient water, by small river boats and launches from Coquille up to Myrtle Point, a farther distance of about 13 miles. During several months of each summer, however, the small boats and launches plying ordinarily between Coquille and Myrtle Point can not go above a point 8½ miles above Coquille, on account of the small volume of the river during the low-water season and a number of bars.

The original project for improvement, adopted in 1892 (report printed in the Annual Report of the Chief of Engineers for 1891, pp. 3280–3283), provided for deepening the channel from Coquille to Myrtle Point to 4 feet at mean low water, by removing snags, and by constructing wing dams at several points to scour out shoals. The width of the improved channel was limited to 50 feet on account of the small volume of the river. The estimated cost of the improvement was placed at $26,000, exclusive of $6,883.90 expended under acts of Congress of August 11, 1888, and September 19, 1890.

The stream was resurveyed in 1894, and it was then found that heavy rains had caused landslides, bringing much silt into the upper branches and into the main stream, resulting in filling the latter with sediment in its more gently flowing portions. The river for 4½ miles below Myrtle Point was much more shallow than was the case farther down, and the conditions in the 1¾ miles from Myrtle Point down to Roberts Landing were particularly bad for navigation.

The revised estimate of cost of completing the improvement (printed in the Annual Report of the Chief of Engineers for 1895, pp. 3350–3351) was $43,176.48, which amount, with the amounts expended from the appropriations made by the acts of Congress of July 13, 1892, and August 18, 1894, brings the estimated total cost to $50,980.77.

The amount expended to June 30, 1899, $22,281.23, resulted in the removal of many snags, in dredging shoals, in the construction of two rubblestone deflecting dikes between Myrtle Point and Roberts Landing, and in confining the channel from Roberts Landing up to Rackliffs Landing, five-eighths of a mile, between two rows of pile dikes about 60 feet apart. This work resulted in obtaining a slightly increased depth in the stream in the immediate vicinity of the places where the work was done.

The expenditures during the fiscal year ending June 30, 1900, were for necessary additional plant for removing some of the larger obstructing snags in the channel between Coquille and Myrtle Point and for dredging several shoals between the same points. This work has been conducted by hired labor and with plant belonging to the United States. It is still in progress, and no especial benefit is expected until it is completed some time during the present summer.

The maximum draft that may be carried at mean low tide during the low-water period each summer in the 10 miles from Coquille up to Norway is about 4 feet, and in the 3 miles from Norway up to Myrtle Point 1 foot. The mean range of the tide at Myrtle Point was said to be formerly 4½ feet, but in late years landslides have occurred along the head waters and the freshets have brought down much sand and gravel, which filled up the bed of the river as far down as Roberts Landing. As the result of this the mean range of the tide at Myrtle Point is at the present time only about 2 feet. A map of the stream between Coquille and Myrtle Point is printed in the Annual Report of the Chief of Engineers for 1895, between pages 3356 and 3357. At many places in the 4½ miles next below Myrtle Point the stream is nothing more than a small creek during the summer months, with barely enough water at times to float a good-sized skiff.

For the above reasons it is considered doubtful by the officer in local charge of the improvement whether the proposed low-water depth of 4 feet at all places between Coquille and Myrtle Point can be obtained and maintained during the summer months at a reasonable cost.

The commerce carried by the small boats and launches plying between Coquille and Myrtle Point (consisting principally of farm products) is inconsiderable, a railroad between Myrtle Point and Marshfield, on Coos Bay, which parallels the river between Myrtle Point and Coquille, affording ample facilities for transporting the limited commerce of the region.

Commercial statistics.

	Tons.		Tons.
1893	1,242	1897	4,293
1894	1,692	1898	4,915
1895	1,409	1899	3,399
1896	3,205		

NOTE.—The statistics for 1893–1895 are for fiscal years ending June 30; for 1896–1899 calendar years,

July 1, 1899, balance unexpended	$8,718.77
June 30, 1900, amount expended during fiscal year	4,863.27
July 1, 1900, balance unexpended	3,855.50
July 1, 1900, outstanding liabilities	643.26
July 1, 1900, balance available	3,212.24
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	19,980.77

(See Appendix U U 3.)

4. *Entrance to Coos Bay and Harbor, Oregon.*—Coos Bay is a tidal estuary on the Pacific coast in Oregon, about 400 miles north of San Francisco. It is the principal harbor between the Columbia River and San Francisco. Before improvement the obstruction which existed at the entrance to Coos Bay consisted, first, of the exterior bar, and second, of inner shoals formed by the sands which accumulated in the spring, summer, and autumn, during the times when the northwesterly storms prevail. Under the influence of these winds the sand spit on the north side of the entrance to the bay advanced toward the south, contracting the navigable channel under Coos Head to a very narrow width, and usually causing the outer channel to follow the west side of the sand spit in a tortuous course across the bar (see middle portion of chart opposite p. 2264 of the Annual Report of the Chief of Engineers for 1884). The low-water depth on the bar was about 10 feet. The mean rise of tide was 5.6 feet.

The original project for improvement approved by the Secretary of War on November 24, 1879 (printed in the Annual Report of the Chief of Engineers for 1880, p. 2323), provided for the "construction of a jetty from a point 250 yards below the northern extremity of Fossil Point on a line toward the east end of Coos Head, this line in plan curving so as to be directed at its outer end to the head, or a little to the north of it, the structure to be of wood and stone, or stone, as may be found best." The object of this jetty was to deflect the ebb tides, so as to hasten the destruction of the southerly end of the north sand spit, to prevent in the future an undue contraction of the channel at Coos Head. The estimated cost of the jetty was placed at $600,000. The position of the jetty is shown to the right on the chart opposite page 2264 of the Annual Report of the Chief of Engineers for 1884.

The present approved project (printed in the Annual Report of the Chief of Engineers for 1890, pp. 2936–2965) provides for the construction of two high-tide rubblestone jetties, the north jetty to extend seaward from the southern end of the north sand spit and the south jetty to start from Coos Head, the two jetties to converge so that the outer entrance shall have a width of about 1,500 feet, their object being to create and maintain a low-water bar depth of at least 20 feet. The estimated cost of this improvement is $2,466,412.20, exclusive of the amount expended on the original project. The positions of the proposed jetties are shown in the chart opposite page 3162 of the Annual Report of the Chief of Engineers for 1891.

The amount expended under the original project for the construction of the Fossil Point deflecting jetty was $213,750, and resulted in the construction of that jetty for the distance of about 1,760 feet. This jetty caused a partial erosion of the southern end of the north sand spit and opened a channel over the outer bar well to the south of and deeper, wider, and less shifting than the original channel.

The amount expended under the present project up to June 30, 1899, $516,727.03, was for partially enrocking the north jetty throughout its entire projected length of 9,600 feet, which resulted in obtaining a channel through the bar at the entrance to the bay with the low-tide depth of from 18 to 22 feet, or 23 to 27 feet at high tide. The projected depth of 20 feet at low tide was, therefore, practically obtained before the north jetty had been enrocked up to its proposed height throughout its projected length of 9,600 feet, and before anything whatever had been done toward constructing the south jetty contemplated in the project for improvement.

The expenditures during the fiscal year ending June 30, 1900, were for a survey of the channel under improvement, and for additional rubblestone placed in the north jetty under a contract dated August 15, 1899. The placing of this additional rubblestone in the jetty resulted in maintaining the depth of 18 to 22 feet at low tide obtained in previous years.

It is estimated that the crest of the incomplete north jetty may be brought up to its projected height at all points with the present available funds.

Inasmuch as the projected depth of 20 feet at low water has nearly been obtained with only one incomplete jetty, it is thought that the full projected depth may possibly be obtained with this jetty alone when it has been completed. Should this be accomplished the necessity for constructing a south jetty would not be apparent.

The commerce that crosses the bar at the entrance of Coos Bay consists principally of coal and lumber, originating at points on and adjacent to the bay. Practically all this commerce is taken to San Francisco in coasting vessels for market. The bay and ocean form the only practicable means of transporting the commerce to market.

Commercial statistics.

	Tons.		Tons.
1883	93,380	1894	109,152
1885	75,718	1895	128,544
1886	109,988	1896	144,934
1890	242,329	1897	115,896
1892	136,065	1898	103,039
1893	109,044	1899	116,567

NOTE.—The statistics for 1895 to 1899, inclusive, are for calendar years; prior to 1895, for fiscal years ending June 30. Statistics for years not named are either not available or are incomplete.

July 1, 1899, balance unexpended		$158,272.97
June 30, 1900, amount expended during fiscal year		62,255.98
July 1, 1900, balance unexpended		96,016.99
July 1, 1900, outstanding liabilities	$17,244.91	
July 1, 1900, amount covered by uncompleted contracts	55,588.29	
		72,833.20
July 1, 1900, balance available		23,183.79
Amount (estimated) required for completion of existing project		1,791,412.20

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U U 4.)

5. *Harbor at Coos Bay, Oregon (dredging).*—A survey in 1891 showed the extent of a number of shoals then existing in the upper portion of Coos Bay and its tributary sloughs that interfered with navigation at low tide. There was a least low-tide depth of but about 5 feet on the principal shoal, known as the "Hogs Back," which was directly opposite Marshfield, the chief town on the bay, and about 12 miles by water from the entrance to the bay from the Pacific Ocean. This shoal was composed mainly of oyster shells and sand, covered with mud probably deposited in the sluggish waters at the mouth of Isthmus Slough, immediately above Marshfield, during times when Coos River (which empties into Coos Bay opposite Marshfield) was in flood. It caused considerable annoyance and delays to the coasting vessels calling at Marshfield, for they were compelled to wait until full high tide before they could approach or leave Marshfield wharves when loaded, or going to and from the coal bunkers situated immediately above Marshfield, near the mouth of Isthmus Slough. Another mud shoal, with a least low-tide depth of 8 feet, in Isthmus Slough opposite the bunkers of the Oregon Coal and Navigation Company, interfered with navigation of the upper end of the bay and in Isthmus Slough.

The act of Congress of August 18, 1894, appropriated $13,000 "for the construction or purchase of a dredger and operating the same in removing obstructions from and deepening the harbor of Coos Bay in front of Marshfield."

The act of Congress of June 3, 1896, appropriated $14,390, with the provision "that so much of this sum as may be necessary shall be added to the amount now on hand for the construction or purchase of a dredge and two hopper scows, and that dredging within the limits of this appropriation may be contracted for in the discretion of the Chief of Engineers, and in such portion of the bay as may be found necessary."

As the localities to be dredged were where the channel was narrow, with broad tide flats alongside, affording very easy disposition of dredged material through a pipe line, but necessitating a very long and expensive tow if a dipper dredge were used and the dredged material handled in dump scows, attention was turned to the question of building a pump dredge and the necessary pipe line instead of a dipper dredge. Investigation proved, however, that it would be practically impossible to use a pipe line without infringing upon certain patents, and the owners of these patents demanded what was considered an unreasonable sum for the right to use their type of appliances.

Under the circumstances it was considered that the best results could be obtained by entering into a contract providing for the necessary dredging, but as the law respecting the purchase or construction of a dredge and scows was considered mandatory, it was decided proper to submit the subject to Congress with the view of having the law changed so as to permit the option of contracting for the work of dregging. The necessary amendment to the original act was made by the sundry civil act approved July 1, 1898, the latter containing the following item:

> That the provisions of the river and harbor acts of August eighteenth, eighteen hundred and ninety-four, and June three, eighteen hundred and ninety-six, making appropriations for improving harbor at Coos Bay, Oregon, by deepening harbor and removing obstructions therefrom, are hereby so amended as to authorize the Secretary of War, in his discretion, to expend any or all of the funds so appropriated in carrying on the required dredging and other work by contract, or in any manner that in his judgment may be most economical and advantageous to the Government.

The project approved by the Secretary of War August 16, 1898, for carrying on the work under the law as amended, provided for dredging such shoals and removing such obstructions in the upper part of the bay as constituted obstructions at that time, instead of limiting the work to dredging the two shoals reported on in 1891, inasmuch as since 1891 these two shoals had changed somewhat and other shoals had formed in the upper part of the bay.

The amount expended to June 30, 1899, $6,420.32, resulted in dredging a channel through the Hogsback Shoal 2,154 feet long, 150 feet wide at the bottom, and 13 feet deep at mean low tide, a channel through Webster Point Shoal, a short distance north of the Hogsback Shoal, 1,518 feet long, 150 feet wide at the bottom, and 13 feet deep at mean low tide, and in dredging to the same width and depth 1,149 feet of a proposed channel 2,410 feet long through the Stave Mill Shoal, a short distance north of the Webster Point Shoal. This dredging was done under contract dated December 16, 1898.

The expenditures during the fiscal year ending June 30, 1900, resulted in completing the channel through the Stave Mill Shoal, thus giving it the total length of 2,410 feet, and in dredging a channel through Bunker Shoal in Isthmus Slough, a short distance southeast of the town of Marshfield, this channel being 1,326 feet long, 100 feet wide at the bottom, and 12 feet deep at mean low tide. This dredging was done under the contract dated December 16, 1898. The location of the four channels dredged under this contract are shown on map opposite page 3206 of the Annual Report of the Chief of Engineers for 1899. An abandoned log raft cradle which had occupied a position in the channel in Coos Bay and obstructed navigation since 1893 was removed by hired labor; a sheet-pile dike 324 feet long was constructed, under an informal contract, connecting an island immediately inside the mouth of Coos River with the south shore of that river, to close up the channel south of the island and divert the flow of the water through the main channel north of the island, the designed effect of this dike being two-fold, i. e., to prevent, as far as possible, the sediment carried by the river during floods from being deposited in the channels previously dredged through Hogsback and Stave Mill shoals and to aid in removing a shoal in the bay at the mouth of the river which interfered with the movements of the small river steamboats plying between Marshfield and points on Coos River. A channel 875 feet long, 60 feet wide, and 7 feet deep at mean lower low tide was also dredged by hired labor and with plant belonging to the United States through the shoal in the bay at the mouth of the river. The foregoing work has resulted in satisfactorily completing the project for removing shoals and other obstructions in Coos Bay. Practically all the commerce of Coos Bay and Coos River is benefited by the dredging, as this commerce is carried in vessels using one or more of the dredged channels. This commerce during the past twelve years has averaged about 125,000 tons per annum.

July 1, 1899, balance unexpended	$20,969.68
February 2, 1900, refundment of overpayment	9.75
	20,979.43
June 30, 1900, amount expended during fiscal year	20,908.71
July 1, 1900, balance unexpended	70.72

(See Appendix U U 5.)

6. *Coos River, Oregon.*—Coos River is the principal tributary of Coos Bay, and empties into the bay at its head, opposite the town of Marshfield. At a point 5½ miles from its mouth it divides into two branches, known as the North and South forks, up each of which tidal influence extends for about 8½ miles. Before improvement was commenced the small, light-draft steamboats and launches that ply between Marshfield and the head of tide on each fork experienced considerable difficulty in navigating on account of the many snags, bowlders, etc., in the stream.

The project adopted in 1896 (printed in the Annual Report of the Chief of Engineers for 1895, pp. 3502–3505) provides for removing snags and bowlders, cutting through bars, etc., where necessary to secure a channel 50 feet wide throughout the 5½ miles in the main river and 8½ miles of each fork at an estimated cost of $5,000. In the Annual Report of the Chief of Engineers for 1898 (p. 2967) it was stated that $3,000 in addition to the $5,000 appropriated June 3, 1896, would be required to complete the project. The additional $3,000 was provided by the act of March 3, 1899.

The amount expended to June 30, 1899, $4,634.06, resulted in the construction of a rubblestone dike 400 feet long at Carpenter Shoal, in South Fork, about 4 miles below the head of navigation, to prevent the bank from sliding into the channel and increase at the same time the depth of water by diverting and confining it to a selected channel, in the removal of many of the larger obstructing bowlders and snags from the main river and the two forks, and in the removal of a number of old piles belonging to an abandoned log boom in the North Fork, which completely inclosed one-fourth of a mile of the channel. This work resulted in enabling the small steamboats and launches to navigate the stream with much less difficulty than before improvement.

The expenditures during the fiscal year ending June 30, 1900, resulted in the removal of all the remaining smaller obstructing snags and bowlders, thereby completing the project. It is believed, however, that a small sum will be required occasionally to maintain the improvement by removing snags, etc., which may come into the stream from time to time.

The maximum draft that could be carried on June 30, 1900, at mean low tide, over the shoalest parts of the locality under improvement varied from 2 to 4 feet.

Coos River flows through a narrow, but productive valley. The commerce carried on the small boats plying the stream consists principally of farm and dairy products, which are brought to Marshfield, where ocean vessels touch, for market. The commerce carried by the river boats to Marshfield is not great, but the stream is the only means of transporting it.

Commercial statistics for calendar years.

	Tons.		Tons.
1896	13,204	1898	22,674
1897	16,534	1899	70,007

July 1, 1899, balance unexpended	$3,365.94
June 30, 1900, amount expended during fiscal year	3,223.86
July 1, 1900, balance unexpended	142.08
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix U U 6.)

7. *Mouth of Siuslaw River, Oregon.*—The Siuslaw River empties into the Pacific Ocean at a point about 475 miles north of San Francisco, Cal. It enters the sea through a shifting sand beach without headlands or other fixed points to mark the entrance, which is obstructed by a shoal outer bar. Before the work of improvement was commenced the channel across this outer bar had a range from north to south of about 1 mile, and the depth of water on the bar varied from 5 to 12 feet at low tide.

The project for improvement, approved by the Secretary of War August 4, 1891 (report printed in the Annual Report of the Chief of Engineers for 1891, pp. 3175–3182), provides for confining the outgoing and incoming waters between high-tide rubblestone jetties, so located as to direct the currents upon the ocean bar in a direction practically perpendicular to the coast, the jetties to converge until they are 600 feet apart at the crest of the bar, the north jetty to be 7,500 feet long, including a tramway approach at the shore end 3,000 feet long, and the south jetty to be 5,600 feet long, including a tramway approach at the shore end 2,400 feet long. With these jetties it is estimated that a depth of 8 feet at low tide will be maintained upon the bar lying in front of the entrance. The estimated cost of the improvement is $700,000. The charts opposite page 3174 and page 3178 of the Annual Report of the Chief of Engineers for 1891 show the positions of the proposed jetties.

The amount expended to June 30, 1899, $121,206, resulted in the construction of a wharf under Cannery Hill for use in transferring rubblestone for the north jetty from scows in the river to dump cars on the wharf and in the construction of 3,940 feet of the north jetty, which includes a tramway 3,029 feet long extending from the wharf to the root of the north jetty proper. This checked the former tendency of the bar channel to shift its position, but did not result in obtaining any appreciable increased depth.

The expenditures during the fiscal year ending June 30, 1900, were for a survey of the entrance to the river, and for extending the north jetty seaward, under contract dated August 15, 1899. Under this contract the jetty has been thus far partially extended seaward 105 feet, giving it the total length from the wharf under Cannery Hill of 4,045 feet. The sea end of the north jetty has not as yet reached a point sufficiently far seaward to have any decided effect on the bar channel other than to fix more permanently its position.

Nothing has been done toward constructing the south jetty, the project providing that the north jetty shall be constructed first, at least in part.

During the past year the maximum draft that could be carried at mean low tide over the shoalest part of the locality under improvement was the same as reported last year—about 7½ feet.

The commerce of the Siuslaw River is limited, the country being but thinly settled. The principal article of commerce is lumber, which is taken from the river to San Francisco in small coasting vessels. The river and ocean form the only means for transporting such commerce as there is, there being no railroad in the vicinity.

Commercial statistics.

	Tons.		Tons.
1892	2,381	1896	7,184
1893	7,000	1897	2,239
1894	8,050	1898	4,350
1895	15,296	1899	4,907

NOTE.—The statistics for 1896–1899, inclusive, are for calendar years; for years prior to 1896 the statistics are for fiscal years ending June 30.

July 1, 1899, balance unexpended		$30,794.00
June 30, 1900, amount expended during fiscal year		7,310.85
July 1, 1900, balance unexpended		23,483.15
July 1, 1900, outstanding liabilities	$4,224.11	
July 1, 1900, amount covered by uncompleted contracts	14,947.10	
		19,171.21
July 1, 1900, balance available		4,311.94
Amount (estimated) required for completion of existing project		548,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900		35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix U U 7.)

8. *Yaquina Bay, Oregon.*—Yaquina Bay is a small tidal estuary of about 5 square miles area, being the mouth in the Pacific Ocean of Yaquina River, a small mountain stream. It lies on the Oregon coast, about 520 miles north of San Francisco, and like all Pacific coast harbors the entrance to the bay was originally obstructed by a sand bar. Prior to improvement the prevailing depth over the bar at the entrance to the bay varied from 7 to 8 feet at low tide, and three distinct channels existed, known as the north, middle, and south channels. The mean rise of tide was about 7 feet. The south channel was the one most used, but was rendered dangerous by the presence of rocks. The middle channel, although free of rocks, was usually the shoalest of the three and was, therefore, seldom used. The north channel, besides being long and tortuous, was so studded with rocks that it was considered unnavigable. Owing to the shifting nature of the bar these channels were constantly changing, both in position and depth.

The act of Congress of June 14, 1880, appropriated $40,000 for the improvement of the entrance to Yaquina Bay. As this appropriation was made without a survey, examination, or report by the Engineer Department having first been made, the officer charged with the duty of submitting a plan for improvement was authorized to first make a careful survey of the harbor. This survey was made in August–October, 1880, and the project for improvement, dated December 11, 1880, as approved by the Secretary of War, provided for constructing a jetty on the south side of the entrance to cause the south channel to shoal up and the flow of the waters to be deflected northward so as to scour out and maintain the central channel with the least depth of 17 feet at high-tide level, the jetty to start from near low-tide line and run out to sea 2,500 feet, and to rise 2 feet above mean low tide. The estimated cost of this jetty was placed at $465,000.

The rubblestone for the jetty was to be deposited in place from barges, and in cribs if practicable. It was found, however, that cribs could not be used, on account of the strong currents and high seas, and that the ocean swell, even in quiet weather, was too great to permit the use of barges. It was necessary, therefore, to build the jetty from the shore end by carrying the rubblestone for it out over a tramway built on piles driven along the line of the proposed jetty, and this change of method of construction necessitated the amendment, in 1882, of the project so as to provide that the enrockment of the jetty be raised to high-tide level, instead of to 2 feet above mean low-tide level. This amendment also made it necessary to start the shore end of the jetty near high-tide line instead of at a point near the mean low-tide line, and this necessitated increasing the proposed length of the jetty from 2,500 feet to about 3,748 feet.

The scope of the project was extended in 1888 (printed in the Annual Report of the Chief of Engineers for 1889, pp. 2517–2521), so as to provide for the construction of a mid-tide jetty on the north side of the entrance, running out to sea in a southwesterly direction from the headland for about 2,300 feet to a point opposite the outer end of the south jetty, so as to give an entrance width of 1,000 feet.

An estimate submitted January 13, 1890 (printed in the Annual Report of the Chief of Engineers for 1890, p. 2967), placed the cost of completing the project at about $370,000, which, with the sums previously appropriated ($385,000), brought the total estimated cost up to $755,000.

In 1892 the project was again amended (printed in the Annual Report of the Chief of Engineers for 1893, pp. 3357–3359), so as to provide that the north jetty should be built up to full high-tide level, to force both the incoming and outgoing waters to pass entirely between the jetties, instead of permitting a portion of them to pass over the north jetty; and, also, to construct 3 groins 100 feet long and 2 groins 60 feet long, from the north side of the south jetty, to protect the latter from the encroachment and undermining action of the channel current, which was taking up a position very close to the south jetty near its outer end.

The sundry civil act of March 2, 1895, provided for the appointment of a Board to consist of three officers of the Engineer Corps, to make an examination of the bar of the Yaquina Bay, in Oregon, with a view to a project for deeper water.

The report of the Board, dated October 11, 1895 (printed in the Annual Report of the Chief of Engineers for 1896, pp. 3284–3309), was that if any further permanent deepening of the bar could be made, it would be only by extending the north jetty 2,100 feet and the south jetty 2,000 feet, the new portions of the jetties to be parallel and 1,000 feet apart, and to be built of heavy riprap brought up to the level of high tide. It was also submitted that, in the event of such further extension of the jetties, the south jetty should have on the channel side groins of riprap every 300 feet to prevent it from being undermined; that a spur 800 feet long should be built from the channel side of the present south jetty for the purpose of obtaining a greater depth of water over the inner bar that had formed in recent years, and that all projecting rocks in the path of vessels should be blasted out to the general level of the rock bottom. The cost of this additional work was estimated by the Board at $1,025,000, making the estimated total cost, including previous appropriations, $1,710,000.

The Board in its report observed that the law did not call upon it "to express any opinion as to whether a further permanent deepening of the water on the bar is practicable, or, if practicable, whether the commerce of the port, present or prospective, will justify a further expenditure." The report, therefore, was silent as to the worthiness or unworthiness of an attempt to further improve the locality at an expense to the United States of over $1,000,000.

The river and harbor act of June 3, 1896, provided for—

> Improving Yaquina Bay, Oregon: Continuing improvement, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the project as recommended by the Board of Officers of the Engineer Corps October eleventh, eighteen hundred and ninety-five, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one million dollars, exclusive of amount herein and heretofore appropriated.

The execution of the work authorized by act of June 3, 1896, was held in abeyance on account of the following-quoted item in the act of March 3, 1899:

> Yaquina Bay, Oregon: The Secretary of War is hereby authorized to appoint a board of three engineers who shall make examination thereof, with a view to ascertaining the desirability of prosecuting the work authorized by the river and harbor Act of eighteen hundred and ninety-six, for such modification thereof as, in the judgment of said board may be desirable for the commerce of said bay, together with an estimate of the cost of such work, and until such report shall have been made and acted upon by Congress, no further action shall be taken by the Secretary of War in pursuance of existing law, and five thousand dollars, or so much thereof as may be necessary, is hereby appropriated to pay the expenses of such examination.

The report of the Board of Engineer Officers appointed by the Secretary of War pursuant to the above-quoted act of March 3, 1899, was printed in House Doc. No. 110, Fifty-sixth Congress, first session (also submitted as Appendix U U 9 of this report), and was to the effect that it was not considered advisable to prosecute the work authorized by the river and harbor act of June 3, 1896, excepting the removal of a cluster of rocks on the side of the channel about 2,000 feet beyond the end of the south jetty. The removal of this cluster of rocks, with the available balance of the appropriation of $25,000 made June 3, 1896, was authorized by the act of Congress approved June 6, 1900.

The expenditures up to June 30, 1899 ($689,161.58), resulted in completing both jetties in accordance with the original project of 1880, and as amended in 1882, 1888, and 1892, with the exception of placing a very small quantity (about 15,000 tons) of stone on the north jetty. This work resulted in fixing the channel in width and location as projected and in obtaining from 14 to 15 feet of water on the bar at mean lower low tide, or from 21 to 22 feet at high tide, whereas the project provided for only 17 feet at high tide, thus obtaining several feet more than was projected. This original amended project may be said, therefore, to be satisfactorily completed.

The expenditures during the fiscal year ending June 30, 1900, were for caring for the work done in previous years and the Government plant stored at the site of the work, and for preparing to remove the cluster of rocks as authorized by the act of June 6, 1900.

The chart opposite page 2680 of the Annual Report of the Chief of Engineers for 1882 shows the position of the three channels at the entrance to the bay at the time the survey was made in 1880. The chart opposite page 3360 of the Annual Report of the Chief of Engineers for 1893 shows the manner in which the south channel has been completely filled up and the middle channel developed through the agency of the jetties.

The maximum draft that could be carried during the fiscal year ending June 30, 1900, at mean low tide, over the shoalest part of the locality under improvement, remained the same as reported in the last Annual Report of the Chief of Engineers—about 15 feet.

It has been ascertained that the commercial statistics pertaining to the bay, as published in the annual reports for 1898 (p. 491) and 1899 (p. 577), are somewhat misleading, the tonnage of vessels arriving at and departing from the bay, instead of the tonnage of the commerce, having been included in the statistics for some of the years without proper explanation of the fact being made. The records of commerce carried into and out of the bay were recently carefully recompiled, and as a result the following table of tonnage of commerce is substituted for that published in the former reports.

	Tons.		Tons.
1882	1,830	1891	27,540
1883	1,359	1892	27,111
1884	4,995	1893	24,767
1885	9,951	1894	23,345
1886	6,249	1895	24,589
1887	24,694	1896	17,883
1888	23,431	1897	15,364
1889	32,921	1898	10,380
1890	40,074	1899	5,990

NOTE.—The statistics for 1882–1894 are for the fiscal years ending June 30; for 1895–1899 they are for calendar years.

July 1, 1899, balance unexpended	$20,838.42
June 30, 1900, amount expended during fiscal year	866.10
July 1, 1900, balance unexpended	19,972.32
July 1, 1900, outstanding liabilities	110.00
July 1, 1900, balance available	19,862.32

(See Appendix U U 8.)

9. Yaquina Bay, Oregon, examination.—As stated in the preceding report, the river and harbor act of March 3, 1899, authorized the Secretary of War to appoint a Board of three engineers to make an examination of Yaquina Bay with a view to ascertaining the desirability of prosecuting the work authorized by the river and harbor act of June 3, 1896, for such modification thereof as, in the judgment of said Board, might be desirable for the commerce of said bay, together with an estimate of the cost of such work, and appropriated $5,000 for making such examination.

The expenditures up to June 30, 1899 ($1,508.09), resulted in commencing the work of making a survey of the bay to obtain reliable data for the use of the Board of Engineer Officers appointed in accordance with the provisions of the river and harbor act of March 3, 1899.

The expenditures during the fiscal year ending June 30, 1900, were for completing the survey of the bay and for the necessary expenses of the Board of Engineer Officers. The Board submitted its report November 14, 1899. The report was printed in House Doc. No. 110, Fifty-sixth Congress, first session, and also forms part of Appendix U U 9 of this report. It was to the effect that the bay is unworthy of further improvement, with the exception of removing to the level of the surrounding bottom a cluster of rocks on the side of the channel about 2,000 feet beyond the end of the south jetty. This work is estimated to cost about $20,000, and provision for its execution was made by the emergency river and harbor act approved June 6, 1900.

July 1, 1899, balance unexpended	$3,491.91
June 30, 1900, amount expended during fiscal year	3,181.51
July 1, 1900, balance unexpended	310.40

(See Appendix U U 9.)

10. *Tillamook Bay and Bar, Oregon.*—Tillamook Bay is an indentation of the Oregon coast, having a tidal area of about 13.5 square miles, and lies about 50 miles south of the mouth of the Columbia River. The mean range of tide in this bay is about 6.5 feet. At low tide the bay presents a succession of sand and mud flats, traversed by four channels of fair depth at the entrance, but which shoal to a low-tide depth of but 1 or 2 feet near the head of the bay. These channels are designated as follows: Bay City Channel, Garibaldi Channel, Middle Channel, and old South Channel. The usual bar exists at the entrance to the bay, but has from 10 to 15 feet of water over it at low tide. Kilchis River, Wilson River, Hoquarten Slough, Trask River, and Tillamook River empty into Tillamook Bay from the southeast. These are mountain streams in their upper portions and tidal sloughs in their lower portions. The map following page 3218 of the Annual Report of the Chief of Engineers for 1899 shows the courses of the above-named channels and streams.

Tillamook City, on Hoquarten Slough, the principal town of the region, can be reached only by light-draft, seagoing vessels at high tide, the route being by way of Garibaldi Channel to the mouth of Hoquarten Slough. The only other places of importance are on the north shore of the bay, and are reached by way of the Bay City Channel. As the only navigable connection between these two channels was originally near the entrance to the bay, vessels going to points on the north shore were compelled to retrace their course nearly to the entrance in order to proceed to Tillamook City by way of the Garibaldi Channel, often thus losing one tide.

The original project adopted in 1888 (printed in the Annual Report of the Chief of Engineers for 1888, pp. 2152-2154) provided for aiding vessels to reach Tillamook City by securing a mean high-tide depth of 9 feet over Dry Stocking Bar, near the mouth of Hoquarten Slough, by means of a deflecting dike to concentrate the water and by removing snags and overhanging trees along Hoquarten Slough as far up as Tillamook City. The estimated cost of this work was placed at $5,200. This estimate was increased to $5,700 in 1890 the additional $500 being required to repair a portion of the dike constructed up to that time at Dry Stocking Bar.

The project was extended upon report of survey dated October 19, 1891 (printed in the Annual Report of the Chief of Engineers for 1892, pp. 2741–2752), to provide for cutting a navigable channel through the sand and mud flat separating Bay City Channel from Garibaldi Channel. This amended project also provided for constructing additional dikes to increase the depth at various points to further aid vessels to reach Tillamook City. The estimated cost of completing the project was placed at $100,000, or $105,700, including previous appropriations.

The expenditures to June 30, 1899, $53,861.14, resulted in cutting a navigable channel through the sand and mud flat separating Bay City Channel from Garibaldi Channel, and in the following-named work designed to increase the flow and depth of water in Garibaldi Channel and Hoquarten Slough so as to aid vessels to reach Tillamook City: The removal of snags and overhanging trees in Hoquarten Slough as far up as Tillamook City; the construction of a dike across the head of Middle Channel; a dike across lower mouth of Kilchis River; a dike across the head of Old South Channel; a dike across the lower mouth of Wilson River; a dike on the north side of Dry Stocking Bar; a dike across the head of South Fork of Trask River; a dike across North Fork of Trask River, and excavating a channel from the North Fork of Trask River to Hoquarten Slough by means of which the waters of both forks of Trask River are emptied into Hoquarten Slough above Dry Stocking Bar.

The channel dredged through the sand and mud flat separating Garibaldi and Bay City channels enables vessels to proceed directly to the head of the bay by way of Garibaldi Channel, after visiting Bay City and other points on the Bay City Channel, without having to return nearly to the entrance of the bay in order to reach the Garibaldi Channel, and the construction of the various deflecting dikes above named resulted in obtaining a channel having the least depth of about 8 feet at mean high tide from the entrance to the bay up to Tillamook City.

The expenditures during the fiscal year ending June 30, 1900, were for minor repairs to several of the deflecting dikes built in previous years, for constructing and equipping a combined dredge, snag, pile driver, and derrick scow, for the construction of several short spur dikes designed to create scour on three shoals in the selected channel leading up to Tillamook City, and for dredging these shoals to aid the effect of these dikes. This has resulted in obtaining a channel having the least depth of about 9 feet at mean high tide from the entrance to the bay up to Tillamook City, as projected. The depth called for by the project has therefore been obtained, but it will be necessary to strengthen and extend some of the existing deflecting dikes in order to maintain it. The work during the past year has been carried on both under informal contracts and by hired labor.

The country in the vicinity of Tillamook Bay is very fertile, and is dependent on water transportation almost entirely, the only other means of reaching it being by stage across the Coast Range of mountains from North Yamhill or Forest Grove, Oreg., on the Southern

Pacific Railroad, and even staging is impossible during the winter months, when there is from 4 to 7 feet of snow in the mountains.

Commercial statistics.

	Tons.		Tons.
1889	3,571	1895	29,742
1890	27,427	1896	25,977
1891	28,292	1897	29,405
1892	33,220	1898	35,885
1893	18,316	1899	36,835

NOTE.—The statistics for years prior to 1896 are for fiscal years ending June 30; since 1896, for calendar years.

Statistics for years not named are not available.

July 1, 1899, balance unexpended	$24,838.86
June 30, 1900, amount expended during fiscal year	12,162.42
July 1, 1900, balance unexpended	12,676.44
July 1, 1900, outstanding liabilities	1,742.52
July 1, 1900, balance available	10,933.92
Amount (estimated) required for completion of existing project	27,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix U U 10.)

11. Upper Columbia and Snake rivers, Oregon and Washington.—This designation includes the 125 miles of the Columbia River from Celilo, Oreg., up to the mouth of the Snake River, and the 150 miles of the latter stream from its mouth up to Asotin, Wash., about 7 miles above Lewiston, Idaho. Both streams between those points were originally much obstructed by rock and gravel bars which caused rapids, the ruling depth over many of which was from 2 to 3 feet at low water, while some were impassable at low water. These bars, together with the narrow and crooked character of the channel at many places, rendered navigation by light-draft steamboats difficult and dangerous.

The original obstructions between Celilo and Asotin are described in detail in the Annual Reports of the Chief of Engineers for 1875 (pp. 772–787) and for 1877 (pp. 1036–1041).

The present obstructions in Snake River in the 66 miles from its mouth up to Riparia, Wash., are described in report of survey printed in the Annual Report of the Chief of Engineers for 1898 (pp. 3013–3024).

The navigable capacity of the Columbia and Snake rivers, and also Clearwater River, Idaho (a tributary of Snake River), and the character and scope of country drained by them are shown in the Annual Reports of the Chief of Engineers for 1885 (p. 2426), for 1886 (p. 1942), and for 1894 (p. 2664).

The condition of Snake River above Lewiston and the character of the country bordering it are described in the Annual Reports of the Chief of Engineers for 1882 (pp. 2716–2722), for 1885 (pp. 2440–2442), and for 1891 (pp. 3285–3294).

An examination of some of the principal obstructions in the Upper Columbia was made as early as 1867.

The first appropriation for the improvement of the Upper Columbia was made by the act of Congress of June 10, 1872.

The improvement of Snake River was added to the project by the act of Congress of August 14, 1876.

As a full and continuous survey of the two streams from Celilo to Asotin has never been made, it is impossible to state the amount that will probably be required to remove all obstructions and construct deflecting dikes where necessary to contract and deepen the water.

The expenditures to June 30, 1899, $281,077.32, resulted in removing some of the worst obstructions to steamboat navigation in both streams, in the construction of a rubblestone wing dike at Log Cabin Rapids in Snake River 38 miles below Lewiston, and in the partial construction of a rubblestone deflecting dike at Wild Goose Island Rapids, 73 miles below Lewiston.

Although the work done has not greatly increased the depth of the streams throughout the distance from Celilo to Asotin, it has increased the depth at many points where the water was originally so shallow as to render light-draft steamboat navigation impossible at low water, and has improved the conditions at the worst points to such an extent that they are less dangerous to competent navigators who are acquainted with them. The construction of railroads along and adjacent to the Columbia and Snake rivers, and the fact that the lower portion of the Snake below Riparia can be navigated during the high-water period of each spring only, caused the steamers to abandon the streams between Celilo and Riparia. Therefore the work of improvement has, since 1882, been confined to that portion of Snake River from Riparia up to Asotin, the object being to obtain and maintain a low-water channel depth of about 4½ feet between those points.

The expenditures during the fiscal year ending June 30, 1900, were for caring for and making minor repairs to the Government plant; for quarrying, by hired labor, rubblestone required to strengthen the dikes at Log Cabin Rapids and Wild Goose Island, and for placing 147.42 tons of stone in the last-named dike. These expenditures resulted in filling up a 75-foot gap in the dike at Wild Goose Island.

High water in Snake River and the lack of steamboats for transporting stone prevented operations from being carried on to a greater extent during the past year.

The existing means of transportation, by both water and rail, along the Columbia and Snake rivers between the mouth of the former in the Pacific Ocean, near Astoria, Oreg., and Lewiston, Idaho, the present head of regular navigation on Snake River, are as follows: Vessels drawing 20 feet of water navigate the 100 miles of the Columbia at all seasons between its mouth in the ocean and the mouth of the Willamette River, and these vessels also ascend the Willamette as far as Portland, Oreg. (the principal Columbia River seaport), 12 miles up the Willamette from the Columbia; the Astoria and Columbia River Railroad operates a rail line between Astoria and Portland which parallels the Columbia and Willamette rivers at all places between those two points; river steamers drawing about 8 feet of water navigate the 120 miles of the Willamette and Columbia between Portland and the town of The Dalles, Oreg.; between The Dalles and Celilo, Oreg., 12 miles, the width of the channel of the Columbia is greatly contracted and navigation is completely obstructed at all times by falls, rapids, and clusters of basalt rock. (Some of the characteristics of the

Columbia River in these 12 miles are shown in photographs following p. 3222, Annual Report of the Chief of Engineers for 1899.) Between Celilo and the mouth of Snake River, 125 miles, the Columbia River is more or less obstructed by rapids, but it was navigated by light-draft steamboats up to about twenty years ago, when the boats abandoned that portion of the stream on account of the completion of the railroad of the Oregon Railroad and Navigation Company. This railroad now extends from Portland to Spokane, Wash., paralleling the Columbia and Snake rivers practically at all places between a point 20 miles east of Portland and Riparia, Wash. From its mouth up to Riparia, 66.7 miles, the Snake can be navigated by steamboats during the higher stages only, the stream between those points being a series of rapids caused by bars, rock ledges, bowlders, and the natural steep slope of the stream, which has a fall of 201.8 feet at low water in the 66.7 miles. Between Riparia and Lewiston, 77 miles, light-draft steamboats navigate the Snake regularly, although there are many rapids and shoals between those points. The boats plying between Riparia and Lewiston are operated by the Oregon Railroad and Navigation Company, and connect with that company's Portland-Spokane rail line, which crosses Snake River at Riparia.

The Northern Pacific Railway Company operates a rail line into Lewiston, which line parallels the Clearwater River from its mouth in the Snake, at Lewiston, up to a point about 3 miles above Kamiah, Idaho, or about 70 miles above Lewiston. At Potlatch, on the Clearwater, 15 miles above Lewiston, another branch of the Northern Pacific Railway, running to Spokane, connects with the line which parallels the Clearwater.

From the foregoing it will be seen that while there are facilities for transporting commerce to and from the fertile country in the vicinity of Lewiston by an all-rail route or by a part rail and part water route, a feasible all-water route between the sea and Lewiston does not as yet exist, the all-water route being broken at all times in the 12 miles between The Dalles and Celilo, and during times of low water in the 66.7 miles between the mouth of Snake River and Riparia.

During the past year the Central Navigation and Construction Company commenced the construction of a portage road along the Washington bank of the Columbia around the obstructions in that stream between The Dalles and Celilo. This company is said to have also purchased one steamboat and contracted for the construction of two others, which latter are being now built. It is the intention of this company, according to statements made by its officers, to transport freight by water between Lewiston and points on the Columbia below Celilo, transferring the freight around the obstructions between Celilo and The Dalles by means of the portage road. The outcome of this attempt to furnish practically an all-water transportation route, during a portion of each year, at least (i. e., when there is a sufficiently high stage of water in the Snake below Riparia), between Lewiston and the sea will be watched with interest by those concerned.

The line of the Snake River Valley Railroad, which, it appears, is to be operated in connection with the Oregon Railroad and Navigation Company, has been surveyed, and the road bed partly graded between Riparia and Lewiston, paralleling Snake River at all places between those points.

The Northern Pacific Railway Company has also made surveys between Riparia and Lewiston with the view of extending its rail line from Lewiston to Riparia.

The commerce of the exceedingly fertile Snake River and Camas Prairie country and the recent developments in mining in this region are the attractions for the establishment of transportation lines in this section.

The balance unexpended July 1, 1900, will be applied to payment of expenses for survey of Snake River required by the emergency river and harbor act approved June 6, 1900, and for caring for Government plant. The estimate for the fiscal year ending June 30, 1902, contemplates the construction of deflecting dikes at Log Cabin and at Wild Goose Island rapids.

The maximum draft that could be carried at mean low water during the fiscal year ending June 30, 1900, over the shoalest point in Snake River in the 77 miles between Riparia and Lewiston (the only portion of the stream that boats navigate regularly) is about 4½ feet.

Commercial statistics.

	Tons.		Tons.
1875	18,230	1894	9,902
1879	65,975	1895	37,100
1884	30,260	1896	25,977
1891	31,400	1897	31,531
1892	19,167	1898	36,923
1893	19,364	1899	45,654

NOTE.—The statistics since 1896 are for the calendar years; those for years prior to 1896 for fiscal years ending June 30. Statistics for years not named are not available.

July 1, 1899, balance unexpended		$7,836.68
July 12, 1899, reimbursement (property transferred)		365.00
		8,201.68
June 30, 1900, amount expended during fiscal year		3,774.60
July 1, 1900, balance unexpended		4,427.08
July 1, 1900, outstanding liabilities		52.00
July 1, 1900, balance available		4,375.08
Amount (estimated) required for completion of existing project		Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900:		
For works of improvement	$5,000.00	
For maintenance of improvement	5,000.00	
		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix U U 11.)

12. *Columbia River at Three-mile Rapids, and the construction and equipment of a boat railway from the foot of The Dalles Rapids to the head of Celilo Falls, Oregon and Washington.*—Vessels drawing 20 feet of water easily ascend the Columbia River from its mouth in the Pacific Ocean to the mouth of the Willamette River, a distance of about 100 miles, and river steamers drawing about 8 feet of water navigate the Columbia up to The Dalles, Oreg., a farther distance of about 110 miles. Between the towns of The Dalles and Celilo, Oreg., 12 miles, navigation is completely obstructed at all times. About

3 miles above The Dalles are Three-mile Rapids, a crooked channel 1,500 feet in length, narrow, and much obstructed by huge rocks, swift currents, and powerful eddies; a short distance farther up are Five-mile Rapids, where for a mile and a half the water rushes with great velocity between precipitous walls of basalt 150 to 300 feet apart; then Ten-mile Rapids, a similar gorge one-half mile in length; and, last, Celilo Falls, with a sheer fall of 20 feet at low water. In these 12 miles the total fall in the stream at low water is about 80 feet. Some of the characteristics of the river in the 12 miles referred to are shown in photographs between pages 3222 and 3223 of the Annual Report of the Chief of Engineers for 1899.

The navigable capacity of the Columbia above Celilo Falls, as well as that of the Snake and Clearwater rivers, and the character of the country which would be benefited by any improvement that would enable steamers to pass the obstructions in the 12 miles of the Columbia from Three-mile Rapids up to Celilo Falls, are described in the Annual Reports of the Chief of Engineers for 1885 (p. 2426) for 1886 (p. 1942), and for 1894 (p. 2664).

The project for providing means for boats to pass the obstructions in the Columbia between Three-mile Rapids and Celilo Falls, adopted in 1894 (printed in the Annual Report of the Chief of Engineers for 1894, pp. 2664–2680), as outlined in the act of Congress of August 18, 1894, is as follows:

> Improving Columbia River, Oregon and Washington, at Three-mile Rapids, and the construction and equipment of a boat railway from the foot of The Dalles Rapids to the head of Celilo Falls, said boat railway to be provided at each terminus with hydraulic lifts and other necessary appliances for the purpose of raising and lowering the boats on suitable cars to and from its tracks, the whole to be located, constructed, and equipped for the passage of eight boats of six hundred tons each in each direction in twelve hours, on the south side of the Columbia River, substantially in accordance with the location and plans submitted by the board of engineers appointed by the President in pursuance of the provisions of the act of Congress approved July thirteenth, eighteen hundred and ninety-two.

The estimated cost of the proposed boat railway is $2,264,467.

The line of the proposed boat railway is shown on the map opposite page 3590 of the Annual Report of the Chief of Engineers for 1895.

The expenditures to June 30, 1899, $27,595.29, resulted in a survey of the line of the proposed boat railway, in acquiring title to part of the land required for right of way and terminal facilities, and in partially preparing plans for the boat railway and its appurtenances.

The expenditures during the fiscal year ending June 30, 1900, were principally for necessary repairs made to U. S. steamer *Cascades*. During the past year, also, efforts were made to acquire title to the remainder of the land needed for the boat railway. The railroad of the Oregon Railroad and Navigation Company encroaches upon or crosses the proposed line of the boat railway at six points, and the land still remaining to be obtained for the boat railway is at these points. It consists all told of 72.58 acres and belongs to the railroad company. At these points the railroad will have to be shifted before the boat railway can be built. The railroad company agreed to surrender these 72.58 acres to the United States for the purposes of the proposed boat railway, provided the United States would exchange therefor 26.75 acres of its land adjoining, needed for their new location, and provided, also, the United States would pay the cost of reconstructing the company's railroad thereon. The consummation of this agreement with the railroad company is awaiting further action by Congress. As the work of grading new roadbed and reconstructing the tracks of the railroad company at the six points above mentioned would involve an additional expense to the United States of about $90,000, and as no appropriation for this proposed boat railway has been made since 1896, the Secretary of War decided to defer further action in the matter until Congress definitely determines whether or not the work of constructing the boat railway shall continue, or whether some other, more feasible, form of improvement shall be pursued. Should Congress decide that work on the boat railway should be prosecuted some provision should be made by which the Secretary of War can effect such exchange of United States land for that of the Oregon Railroad and Navigation Company as may be necessary to secure a complete right of way for the boat railway.

It is not practicable to positively foretell what benefit would ensue from some kind of improvement that would enable freight to be passed around the obstructions in the 12 miles between The Dalles, Oreg., and Celilo, Oreg. When the character of the country in the vicinity of the Upper Columbia and its tributaries is considered, it is quite probable that such improvement would result in a very great benefit to the Upper Columbia River country, providing, as it would, an all-water route for the shipment of grain, the principal commodity of the region. Much of this grain is exported to Europe and Asia. At present it is brought by rail to Portland and Seattle and loaded into ocean vessels at those points. With boats plying on the Upper Columbia River it is believed that transportation facilities would be afforded sections of country that now have not even rail transportation.

It seems proper to state that I am informed that the steamboat men and others interested in the proposed improvement between The Dalles and Celilo do not regard the construction of the proposed boat railway with favor. They prefer a portage road, or canals and locks. A portage road would perhaps answer every purpose for several years to come, and it could be constructed, equipped, and operated at far less expense than the boat railway.

During the past year the Central Navigation and Construction Company has commenced the construction of a portage road on the Washington side of the river between The Dalles and Celilo. I am informed that this company also purchased one steamboat and contracted for the construction of two others. It is the expressed intention of this company to carry on the business of transporting freight and passengers by boat between points on the Columbia River below The Dalles and by boat between points on the Columbia and Snake rivers above Celilo, the portage road between The Dalles and Celilo to be used for passing freight and passengers around the obstructions in the river between those points.

Boats now navigate, daily, the 210 miles of the Columbia between The Dalles and the Pacific Ocean, and there is no question about the condition of that portion of the Columbia for purposes of navigation.

On the other hand, the Columbia above Celilo, and the 67 miles of the Snake River between its mouth and Riparia, Wash., are considerably obstructed by rapids and shoals, and the outcome of an attempt to regularly navigate these portions of the two streams at all seasons is more or less problematical. Light-draft steamboats once navigated the Columbia between Celilo and the mouth of Snake River. Navigation between those points ceased, however, about twenty years ago, when the rail line of the Oregon Railroad and Navigation Company was constructed along the south shore of the river. Although Snake River in the 77 miles between Riparia, Wash., and Lewiston, Idaho, is more or less obstructed by rapids, that portion of Snake River is now navigated all the year round by light-draft steamboats. A full and continuous survey of the Columbia above Celilo has never been made, therefore detailed information concerning all the obstructions in the stream above that point is lacking. Owing to the uncertainty of the outcome of the attempt to regularly navigate the Columbia above Celilo, and the Snake between its mouth and Riparia, considerable doubt exists as to the advisability of constructing at this time the proposed boat railway between The Dalles and Celilo, at an estimated cost to the United States of $2,264,467. If the Central Construction and Navigation Company carries out its proposed attempt to furnish an all-river means of transportation from Lewiston to the Pacific Ocean, it will be the means of obtaining much valuable information as to the most feasible form of improvement between The Dalles and Celilo. As stated above, no boats now ply the Columbia between Celilo and Snake River, and no commerce is now handled by river, consequently the character of boats and the probable volume of commerce that improvements between Celilo and The Dalles should be designed to accommodate are at present largely conjectural. Before any very great sum is expended by the United States in improvements of a permanent character the fullest information should be at hand concerning the character and volume of the commerce to be accommodated.

The act of June 6, 1900, authorized an examination and survey between The Dalles rapids and Celilo Falls with the view to the construction of a canal and locks to overcome the obstructions to navigation, instead of overcoming the obstructions by means of the proposed boat railway. The report of the local officer, dated June 22, 1900, was to the effect that the locality was worthy of improvement to the extent of making the survey, and the latter has been authorized by the Secretary of War. The results of the survey will be transmitted as soon as practicable.

July 1, 1899, balance unexpended	$222,404.71
June 30, 1900, amount expended during fiscal year	2,113.22
July 1, 1900, balance unexpended	220,291.49
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,014,467.00

(See Appendix U U 12.)

13. Canal at the Cascades, Columbia River, Oregon.—The Cascades of the Columbia River are about 45 miles east of Portland, Oreg.

In passing through the Cascade Mountain Range the channel of the Columbia River for the distance of about 4½ miles is so contracted in width that that portion of the stream partakes of the nature of a gorge compared with the width of the channel before it reaches the Cascade Mountain Range and after it leaves it. In the upper 2,500 feet of this gorge (shown in photograph No. 409, following page 3224, Annual Report of the Chief of Engineers for 1899), there is a fall of about 24 feet at low water, which, on account of the rapids and huge bowlders, can not be navigated. Throughout the lower portion of the gorge, about 4 miles, the channel, while not as contracted nor of as steep slope as the upper 2,500 feet, is nevertheless so contracted and of such slope that rapids are formed that can not be navigated during the higher stages. This lower portion of the gorge, also, was originally much obstructed by large bowlders and reefs.

The scope and character of the country drained by the Columbia River, and the benefits which would accrue to it from the improvement of the upper portion of the stream for purposes of navigation, are cited in the Annual Reports of the Chief of Engineers for 1885 (p. 2426) and for 1886 (p. 1942).

The difficulties encountered in preparing definite and detailed plans for improving the locality known as the Cascades are described as follows in the report of a Board of Engineer Officers (printed in the Annual Report of the Chief of Engineers for 1895, p. 3577):

> The work to surmount the Cascades of the Columbia River has no counterpart. It is also without precedent in the conditions surrounding it. At its inception and during its progress the conditions to be met were unknown, but by observations are gradually being revealed.
>
> When the work of improvement began, no records or observations existed giving information with reference to the physics and hydraulics of the Columbia River, or its capacity for navigation; nothing was known as to the phenomena accompanying the various phases of floods at the Cascades, such as the variations in the differences in level at head and foot of rapids during the progress of floods. No record existed of the heights of water at extreme stages, so essential in planning a work subject to such contingencies and dangers.

The original project for improvement (report of Board of Engineer Officers, printed in the Annual Report of the Chief of Engineers for 1878, pp. 1333–1344) provided for a lockage, available at all stages, around the upper (principal) rapid at the Cascades by means of a canal on the Oregon shore about 3, 000 feet long, and two locks (combined) 300 feet by 70 feet, with 14 and 12 foot lifts and an extreme low-water draft of 8 feet.

It being considered that boats could not navigate the rapids below the proposed canal during high stages, the project was modified in 1880 (report of Board of Engineer Officers printed in the Annual Report of the Chief of Engineers for 1881, pp. 2570–2582) to secure navigation through the canal at all stages up to 20 feet only above low water at the foot of the upper rapids by constructing a single lock 462 feet by 90 feet, with a lift of about 24 feet, and a guard gate at the head of the canal, 462 feet above the upper lock gate, to exclude the high water, future work to be conducted, however, with the view of making the canal available for use at stages higher than 20 feet above low water at the foot of the upper rapids should it be found later on that the improvement of the rapids below the canal permitted boats to reach the canal during higher stages. This modification also provided for improving the rapids below the canal by removing the obstructing rocks and reefs.

The original plans provided for wooden guard and lock gates. In 1888 the plans were changed to provide for steel gates (report of Board of Engineer Officers printed in the Annual Report of the Chief of Engineers for 1889, pp. 2551–2559).

The improvement of the rapids below the canal, under the modified project of 1880, having resulted in demonstrating that they could be navigated at much higher stages than 20 feet above low water at the foot of the upper rapids, the project was again modified in 1894 (report of Board of Engineer Officers printed in the Annual Report of the Chief of Engineers for 1895, pp. 3571–3582) to provide for utilizing that portion of the canal between the upper gates of the lock and the upper guard gate as a second lock by putting in a concrete floor and side walls, thus making the canal available for use during all stages up to 42 feet above low water at the foot of the upper rapids. This modification also provided for raising the protection works of the canal, the height of which had been based on the flood of 1876, the highest water known previous to 1894, to make them conform to the flood height of the latter year, which was 6 feet above that of 1876.

There has been $3,748,000 appropriated for this work, and the amount (estimated) required to be appropriated for its completion is $259,260, thus making the total estimated cost $4,007,260.

The location of the canal and locks, and the rapids and contracted condition of the stream opposite and below the canal, are shown on the chart opposite page 2247 of the Annual Report of the Chief of Engineers for 1884.

The expenditures up to June 30, 1899, $3,665,541.72, resulted in the construction of the canal and locks, as projected, to a point where navigation through them is permitted, and in the removal of many of the obstructions in the rapids below the canal and locks.

Although in an incomplete state, the works were opened to navigation on November 5, 1896, and have been used since that time by boats except when high water made it impossible. The condition of the work, as of June 30, 1899, is shown in eight photographs following page 3224 of the Annual Report of the Chief of Engineers for 1899.

The expenditures during the fiscal year ending June 30, 1900, were for rebuilding, by contract, the protection embankment or wing which separates the lower entrance to the canal from the river, and for repairing the slope wall on the south side of the lower entrance to the canal. These portions of the work were damaged by the unprecedented flood of 1894.

With the balance unexpended July 1, 1900, and the funds to be provided for the fiscal year ending June 30, 1902, it is proposed to complete the walls of the upper lock, and do such grading, paving, etc., contemplated by the project as the money available will permit.

Vessels drawing 20 or more feet of water ascend the Columbia River from its mouth in the Pacific Ocean up to a point 2½ miles below Vancouver, Wash., or a distance of about 100 miles, and the canal and locks at the Cascades, together with the improved condition of the rapids immediately below the canal and locks, afford means for steamers drawing 8 feet of water to run up to The Dalles, Oreg., a farther distance of about 110 miles, at all stages up to 36 feet above low water, as shown on the lower gage at the canal.

The commerce that has passed through the canal is as follows: 1898, 18,812 tons; 1899, 16,700 tons; 1900, 17,710 tons. These statistics are for fiscal years ending June 30.

July 1, 1899, balance unexpended		$82,458.28
June 30, 1900, amount expended during fiscal year		31,806.54
July 1, 1900, balance unexpended		50,651.74
July 1, 1900, outstanding liabilities	$8,926.61	
July 1, 1900, amount covered by uncompleted contracts	18,482.06	
		27,408.67
July 1, 1900, balance available		23,243.07
Amount (estimated) required for completion of existing project		259,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		90,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U U 13.)

14. Operating and care of canal and locks at the Cascades of the Columbia River, Oregon.—The obstructions existing in the Columbia River at the Cascades are described in the preceding report. The canal and locks which pass steamboats around these obstructions were opened to navigation on November 5, 1896, although incomplete in many details, and have been in condition to be used ever since that date, with the exception of a few days, when minor repairs were in progress.

The expenditures up to June 30, 1899 ($13,652.13), were principally in payment of salaries of employees engaged in operating and caring for the canal and locks and for a new valve for the main culvert on the south side of the lower lock, to replace a former valve which had become disabled.

The expenditures during the fiscal year ending June 30, 1900 ($5,296.13), were in payment of salaries of employees engaged in operating and caring for the canal and locks, in constructing a sand-blast machine for use in removing old paint, etc., from the steel lock gates preparatory to repainting the latter, in purchasing the necessary paints and oils, and in commencing the work of repainting the gates.

Before the canal and locks were opened to navigation it was necessary to transfer freight around the Cascades by land.

The commerce that has passed through the canal and locks during fiscal years ending June 30 is as follows:

	Tons.
1898	18,812
1899	16,700
1900	17,710

(See Appendix U U 14.)

15. Columbia River, between Vancouver, Wash., and the mouth of Willamette River.—The city of Vancouver, Wash., is located on the Columbia River, 103 miles above its mouth and 5 miles above the mouth of the Willamette River in the Columbia.

Vessels drawing up to 20 feet of water can easily ascend the Columbia from its mouth up to a point 2½ miles below Vancouver, where a bar with but 9 feet of water over it is encountered. After passing this bar a channel 20 or more feet deep is again found which extends above the limits of Vancouver. This bar is evidently due largely to the fact that at low water about 36 per cent of the volume of the Columbia River passed originally south of Hayden Island, opposite Vancouver.

The project adopted in 1892 (printed in the Annual Report of the Chief of Engineers for 1892, pp. 2865–2869) provided for constructing a pile, brush, and stone dam about 3,000 feet long from the Oregon shore to the head of Hayden Island to stop the flow south of the island during low-water stages and deflect it down the main channel north of the island, so as to scour the bar below Vancouver and obtain a depth over it sufficient to permit vessels drawing 20 or more feet to reach Vancouver. The estimated cost of the improvement was $33,000.

During the spring of 1893, after all but 60 feet of the dam next Hayden Island had been completed, high water submerged the dam and the island. When the water receded it was found that the head of the island and a portion of the dam had been carried away.

A special report (printed in the Annual Report of the Chief of Engineers for 1896, pp. 3264–65), submitted in compliance with Senate resolution of December 24, 1895, stated that $67,000, in addition to the $33,000 previously appropriated, would be required to rebuild and complete the dam and to dredge the bar should it be found necessary to supplement the effect of the dam by dredging.

Between December 20, 1897, and April 9, 1898, that portion of the dam next to Hayden Island that was carried away by the high water of 1893 was rebuilt, and the head of the island was revetted to prevent erosion, so that the work was completed, as shown on map between pages 2988–89, Annual Report of the Chief of Engineers for 1898. The dam was submerged by high water immediately after this work was completed, April 9, 1898, and when the high water receded it was found that the current had cut around the two cross dikes connecting the main dike with the head of Hayden Island, and had again carried away the head of the island. The two cross dikes were rebuilt, and additional revetment was placed on the head of the island, in January–May, 1899. The dikes and revetment work on the head of the island were submerged by the usual all-summer high stage of water upon the completion of the work in May, 1899, but when this high water receded the dikes and revetment work were found to be in excellent condition, only a small area of the revetment requiring repairs, and the dikes requiring a small amount of brush and rubblestone filling to compensate for settlement that had taken place.

The soil of this island is of such character that it is easily cut and washed away, and, moreover, the head of the island is head on to a constant current during the summer months, when the Columbia River is kept at a high stage, amounting to a flood, by the melting of snow in the mountains.

The expenditures to June 30, 1899 ($85,533.16), resulted in nearly completing the dike in 1893, and in repairing and completing it and revetting the head of the island between December 20, 1897, and April 9, 1898, and in again repairing it and revetting the head of the island in January–May, 1899. The map following page 3230, Annual Report of the Chief of Engineers for 1899, shows the work as completed in May, 1899. The photographs following the map were made a few days before the work was completed at that time.

Inasmuch as portions of the dike were carried away in the two instances above cited, thus preventing the necessary scouring effect to be brought to bear on the bar during the low-water periods in the winter months, during which periods the dike is designed to produce the greatest scour, and as the new dike had not been completed long enough, no appreciable increased depth on the bar was obtained up to June 30, 1899.

The expenditures during the fiscal year ending June 30, 1900, were for a small quantity of revetment placed on the head of Hayden Island, for additional brush and rubblestone placed in the main and two cross dikes to compensate for the settlement of the brush and rubblestone filling previously placed in the dikes, and for a survey of the river from a point a short distance below the lower end of the island to a short distance above the upper end of it. This survey was made in September and October, 1899, or about six months after the work was finally completed in May, 1899. The survey showed that during those six months but little, if any, scour had taken place on the shoals in the main channel north of the island. However, this survey was made at the termination of the usual all-summer high-water stage in the river, and as the work is designed to produce the greatest scour during low or medium stages, it is not believed that the results shown by this survey can properly be regarded as final. It is the opinion of the officer in local charge of the improvement that the extent to which the dike may ultimately cause scour on the shoals north of the island can not be determined until at least two low-water seasons have elapsed or until the autumn of 1901.

The bars in question do not seriously interfere with the movements of the river steamers, drawing 6 or 7 feet of water, that navigate the Columbia River between its mouth and The Dalles, Oregon, a distance of about 210 miles. The existing commerce could therefore possibly be carried over the bar opposite Vancouver without difficulty in the future as it has been in the past.

The principal object of this improvement is to create a channel to make it possible for ocean vessels to reach Vancouver. Whether the industries of Vancouver could offer vessels drawing 20 feet of water sufficiently attractive inducements in the way of cargoes to make it an object for them to call at that place can not be definitely determined until the depth required to enable such vessels to reach Vancouver has been obtained; but it is suggested that provision be made at once for dredging the bar, as contemplated by the project, in order that the money may be available should such dredging become necessary in the near future. An estimate of $10,000 is accordingly submitted for this work for the fiscal year ending June 30, 1902. With the balance unexpended July 1, 1900, and a portion of the estimate for 1902, it is proposed, if found necessary, to place additional stone in the dike to compensate for settlement that is expected to take place in the brush and stone filling.

July 1, 1899, balance unexpended		$14,466.84
February 2, 1900, refundment of overpayment		1.00
		14,467.84
June 30, 1900, amount expended during fiscal year		9,007.82
July 1, 1900, balance unexpended		5,460.02
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900:		
For works of improvement	$10,000.0	
For maintenance of improvement	8,000.00	
		18,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.		

(See Appendix U U 15.)

16. *Clearwater River, Idaho.*—The Clearwater River empties into the Snake River at Lewiston, on the western boundary of Idaho. An examination of this stream from a point on the South Fork, near Mount Idaho, to its mouth in the Snake River, at Lewiston, a distance of about 84 miles, made in the fall of 1878, developed the fact that the 40 miles of the stream next above Lewiston was the only portion that could be improved for low-water navigation without the expenditure of a much greater sum than was warranted by the commerce of the region. The stream, even in the 40 miles next above Lewiston, was much obstructed by rapids, shoals, rocks, etc., and the original project adopted in 1879 provided for obtaining a low-water depth of 4½ feet, and a navigable width there for small steamers, by removing the natural obstructions, at an estimated cost of $34,424. (Annual Report of the Chief of Engineers for 1879, p. 1855.)

Another examination of the stream was made in 1883, and a revised estimate (printed in the Annual Report of the Chief of Engineers for 1884, p. 2280) placed the cost of completing the work at $87,000, in addition to $15,000 previously appropriated.

No appropriations having been made from August 2, 1882, to June 3, 1896, operations were abandoned.

The act of Congress of June 3, 1896, appropriated $25,000 for continuing the improvement of Clearwater River. A complete survey from the junction of the Middle and South forks down to Lewiston was made in the fall of 1896, and as the result of the information obtained by this survey the project for improving the river for low-water navigation was abandoned, and instead a project was adopted providing for high-water navigation for light-draft steamboats, at an estimated cost of $35,000, exclusive of the $15,000 expended under the former project, and including the $25,000 appropriated June 3, 1896.

The expenditures to June 30, 1899, $36,904.58, resulted in the partial removal of obstructing rocks, under the original project for low-water navigation, and in the removal of some of the worst obstructions to high-water navigation, under the modified project, from Kamiah, Idaho, about 67 miles above Lewiston, down to Big Eddy, about 27 miles above Lewiston.

The expenditures during the fiscal year ending June 30, 1900, were for watching and caring for the Government plant used in past years in improving the stream.

Owing to the steep slope of the stream (an average of about 7 feet to the mile in the 67 miles from Kamiah down to Lewiston), it can not be permanently improved for navigation all the year round except at enormous cost, compared with which the present commerce, or that which may be reasonably expected to be developed in the near future, is utterly insignificant.

At low stages there is not sufficient depth of water in the stream to enable boats to navigate it, while, on the other hand, boats can not ascend it during the higher stages, on account of the swift current. Therefore navigation is practicable during only a short period—a month or six weeks—each spring, when the river is at a "medium-high" stage.

The country that may be said to be tributary to the river is as yet but thinly settled.

The principal article of commerce is wheat, which in past years was taken during periods of "medium-high" water by several steamboats operated by the Oregon Railroad and Navigation Company, principally from points along the 30 or 40 miles of the river immediately above

Lewiston down to Riparia, Wash., on Snake River, about 75 miles below Lewiston, where it was shipped by rail to Portland, for export to Europe and Asia. During the past year, however, these boats have practically abandoned the Clearwater River, owing to the difficulties and dangers connected with attempts to navigate it, to the small amount of commerce, and also owing to the fact that the Northern Pacific Railway Company has constructed a rail line which parallels the river from its mouth at Lewiston up to a point a few miles above Kamiah.

The Clearwater Valley Railroad which, it appears, is to be operated in connection with the Oregon Railroad and Navigation Company, is also projected to parallel the stream from Lewiston up to a short distance below the junction of the North and South forks, or a distance of about 30 miles.

The Snake River Valley Railroad, which also, it appears, is to be operated in connection with the Oregon Railroad and Navigation Company, has been surveyed and partly graded from Lewiston along the north bank of Snake River down to Riparia, at which latter point it will connect with the existing rail line of the Oregon Railroad and Navigation Company extending from Portland, Oreg., to Spokane, Wash., and which has been in operation for some years.

The officer in local charge of the improvement of the Clearwater River reports that the construction of such of the railroads as are already completed renders easy the transportation of the limited amount of commerce offered along this stream.

Steamboats have already either temporarily or permanently abandoned the stream, owing to lack of sufficient business and dangers of navigation. These conditions were reported to the Secretary of War July 6, 1899, who authorized, July 8, 1899, that the unexpended funds be held in the Treasury for the present to await future developments regarding the necessity for further improving the stream.

Commercial statistics.

	Tons.
1896	2,900
1898	756
1899	176

NOTE.—The above statistics are for calendar years. Statistics for years not named are not available.

July 1, 1899, balance unexpended	$13,097.92
June 30, 1900, amount expended during fiscal year	221.74
July 1, 1900, balance unexpended	12,876.18
July 1, 1900, outstanding liabilities	60.00
July 1, 1900, balance available	12,816.18

(See Appendix U U 16.)

EXAMINATION OF SNAKE RIVER FROM ASOTIN, WASH., TO PITTSBURG LANDING, OREG., MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination of *Snake River from Asotin, Wash, to Pittsburg Landing, Oreg.*, required by the river and harbor act of March 3, 1899, was made by the local engineer, Capt. William W. Harts, Corps of Engineers, and report thereon, dated September 29, 1899, submitted through the Division Engineer, Col. S. M. Mansfield, Corps of Engineers. In the opinion of Captain Harts, concurred in by the division engineer and by me, the locality is not worthy of improvement by the General Government. The report was transmitted to Congress and printed in House Doc. No. 75, Fifty-sixth Congress, first session. (See also Appendix U U 17.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Columbia River, between the foot of The Dalles Rapids and the head of Celilo Falls, Oregon and Washington, with the view to the construction of a canal and locks to overcome the obstructions to navigation.*
2. *Snake River, in the States of Idaho and Washington, from the head of navigation on said river to the point of junction with the Columbia River, with a view to improving said river.*

IMPROVEMENT OF WILLAMETTE AND LOWER COLUMBIA RIVERS AND THEIR TRIBUTARIES, OREGON AND WASHINGTON.

This district was in the charge of Capt. William C. Langfitt, Corps of Engineers, to June 21, 1900, with Lieut. Amos A. Fries, Corps of Engineers, under his immediate orders to September 29, 1899, and in the temporary charge of Capt. William W. Harts, Corps of Engineers, since June 21, 1900. Division Engineer, Col. S. M. Mansfield, Corps of Engineers.

1. *Long Tom River, Oregon.*—The Long Tom River is a tributary of the Willamette. It rises on the eastern slope of the Coast Range, drains an area of about 430 square miles, including a large amount of very productive valley land, and empties into the Willamette River 122 miles distant from Portland by river.

At the time of adoption of the present and original project (Annual Report of the Chief of Engineers for 1898, p. 3045) the river was almost impassable on account of the numerous brush-covered shoals and overhanging trees. It is very narrow and runs so low during the spring and summer that scarcely 6 inches of water is found on the bars, but during the winter or rainy season a depth of 5 or 6 feet is found, and the improvement was intended to furnish relief during such parts of the year as high water prevails.

The present project for improvement was adopted in 1898, and was approved by the Secretary of War on May 27, 1899. It provided for the removal of snags, overhanging trees, etc., with a view to obtaining a channel for high-water navigation during a few months in the rainy season. This project is now satisfactorily completed.

The river and harbor act of March 3, 1899, transferred $3,000 from funds previously appropriated for improvement of Willamette and Yamhill rivers to this work. All of this amount was expended during the fiscal year ending June 30, 1900.

The season's work has resulted in securing an open river to the town of Monroe and a navigable channel for light-draft boats during such time of the year as a sufficient stage of water exists. At the close of the fiscal year the water is too low to admit of navigation, but the desired result has been accomplished and the expected benefit derived therefrom.

About 300 tons of grain were marketed over this stream during the fiscal year, which were the first shipments in twenty years.

July 1, 1899, balance unexpended	$3,000.00
June 30, 1900, amount expended during fiscal year	3,000.00
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V V 1.)

2. *Willamette River above Portland, and Yamhill River, Oregon.*—The Willamette River rises in the Cascade Range about 150 miles southward of the Columbia River, and flows northerly, generally parallel and about 50 miles east of the coast line. It enters the Columbia about 105 miles above its mouth and 12 miles north of the city of Portland.

The Yamhill River rises in the Coast Range, flows in a northeasterly direction, and enters the Willamette about 40 miles above its mouth.

A detailed description of the Willamette River, together with that of its condition prior to improvement, may be found in the Annual Reports of the Chief of Engineers for 1876, page 654, and for 1880, page 2280.

The Yamhill River drains an exceedingly fertile valley, which has been settled for years. Prior to improvement the channel was obstructed by snags and rocks, which were removed under the project of 1892, and boats could then reach Dayton (about 5 miles) at all seasons on a draft of about 2½ feet. Above Dayton and about 1 mile below Lafayette the channel was obstructed by rapids, so that boats could reach Lafayette (9 miles) and McMinnville (about 18 miles) only during extreme high water.

The original project for improvement of the Willamette was adopted in 1870 (Annual Report of the Chief of Engineers for 1871, pp. 97 and 901) and modified in 1878 and 1879 (Annual Report of the Chief of Engineers for 1880, pp. 238 and 2275), and in 1892 it was extended to include the removal of obstructions in the Yamhill to McMinnville (Annual Report of the Chief of Engineers for 1893, p. 455).

The present approved project (Annual Report of the Chief of Engineers for 1896, p. 3310, and for 1897, p. 506) proposes, and the river and harbor act of June 3, 1896, and sundry civil act of June 4, 1897, provided for, the improvement of the Willamette River from Portland to Eugene by the removal of obstructions and the building of controlling works, with a view of obtaining a depth of 12 feet or more from Portland to the foot of Clackamas Rapids (11 miles); of 3 to 3½ feet thence to Corvallis (107 miles), and of from 2 to 2½ feet from Corvallis to Eugene (53 miles); estimated cost, $131,697. On the Yamhill River the project contemplated the construction of a lock and dam near Lafayette and the removal of obstructions, to provide a draft of 3½ feet throughout the year from the mouth of the river to McMinnville; estimated cost, $69,000.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $373,389.62, of which $71,373.75 was expended prior to the adoption of the project of 1878.

A number of shoals between Portland and Salem, impassable at extreme low water the year before, had been improved, while during

1898–99 boats operated to Salem throughout the year with only occasional difficulty in crossing a shoal at Ash Island, about midway to Salem.

Dam and shore revetment were built during 1899–1900 at Ash Island, and depths on shoals were sufficiently increased thereby, so that thus far this season no trouble has been experienced by steamboats in reaching Salem and Independence. The river has been carefully snagged and an increase of depth is found on shoals where dams have been previously constructed.

The constant movement of the gravel bed of the river, however, makes it impracticable to secure permanent results without continuous work of snagging and dam construction, as the improvement of one locality usually develops additional difficulties at other points.

Suspension of operations on the Willamette River in April was made necessary owing to the lack of funds. An allotment of $5,000 for snagging was made July 7, 1900, from the appropriation contained in the emergency river and harbor act approved June 6, 1900.

Operations by the contractors on the lock and dam in the Yamhill River began in July; were suspended in October owing to high water, and a further extension owing to the breaking of the cofferdam the third time was granted to October 1, 1900, in which to complete the work. Both walls of the lock are completed and the gates and maneuvering machinery in position. Work was resumed in May, is now in progress, and should be completed during the present working season.

From four to six steamers operate throughout the year between Portland and points on the Upper Willamette, and from indications at present stage of river (about 2 feet above low water) it is thought the maximum draft that can be carried between Portland and Salem during time of extreme low water will be from 24 to 30 inches. Eugene can be reached only on a 6-foot stage. Boats are at this date making trips to Independence, and the least depth obtained at present stage is 4 feet on Eola Bar.

Comparative statement of the tonnage carried by river boats on the Willamette River above Portland.

Calendar year.	Merchandise.	Passengers.	Calendar year.	Merchandise.	Passengers.
	Tons.	*Number.*		*Tons.*	*Number.*
1894	74,615	56,368	1897	186,621	87,960
1895	130,870	57,376	1898	112,154	67.524
1896	218,480	48,465	1899	117,782	50,738

July 1, 1899, balance unexpended	$72,110.38
June 30, 1900, amount expended during fiscal year	56,392.21
July 1, 1900, balance unexpended	15,718.17
July 1, 1900, outstanding liabilities	7,445.45
July 1, 1900, balance available	8,272.72
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance available July 1, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V V 2.)

3. *Columbia and Lower Willamette rivers below Portland, Oreg.*—The Columbia River is the great river of the Pacific coast. It rises in British Columbia, flows southerly and westerly, and forms in its lower portions for 330 miles the boundary between Oregon and Washington, emptying into the Pacific Ocean between these two States.

The Willamette River rises in the Cascade Range about 150 miles southward of the Columbia River, flows northerly, entering the Columbia about 105 miles above its mouth and 12 miles north of the city of Portland.

The portions of these rivers covered by this improvement include the 12 miles of the Willamette between Portland and its mouth and 98 miles of the Columbia from the mouth of the Willamette to the sea.

The original condition of these rivers from Portland to the sea was such that only from 10 to 15 feet could be carried over the shoal places at low water. Numerous sand bars obstructed navigation to deep-water craft and distributed the water over an extended area, so that the greatest depth could be carried over them in only a comparatively narrow channel.

The value and the availability of this waterway for purposes of commerce is proven by the quantities of grain and produce that through it find an outlet to the markets of the world from Oregon, Washington, and Idaho. Its improvement to navigation for deep-water craft is of the utmost importance to the entire northwest section of the country, whose inhabitants find the natural outlet for their produce through the valley of the Columbia.

The original project was adopted in 1877, and was prepared by the Board of Engineers for the Pacific coast with a view of obtaining a channel depth of 20 feet. Prior to this, dredging had been done at shoal places for temporary relief. In 1891 (Annual Report of the Chief of Engineers for 1892, p. 2850) the project was extended to provide for a low-water channel depth of 25 feet, and the Port of Portland Commission, a corporation existing under the laws of the State of Oregon, was granted permission to assist in carrying it into execution.

A further project for securing a 25-foot channel to the sea was prepared, based on a survey authorized by act of March 3, 1899, report of which, dated April 12, 1900, is printed in House Doc. No. 673, Fifty-sixth Congress, first session, and is also submitted as Appendix V V 11 of this report. The estimated cost of completing the work provided for in this report is $2,796,300, $175,000 as cost of new dredge and accessories and $50,000 for annual maintenance.

The total amount expended on this improvement to June 30, 1899, was $1,158,795.78, of which amount $221,780.46 was expended prior to the adoption of the project of 1877.

At the beginning of the fiscal year the conditions were as follows: Ships drawing 23 feet had little difficulty in navigating the shoals by taking advantage of the tides. The adaptability of these waters for purposes of navigation is proven by the vast quantities of lumber and cereal products that are annually transported to market.

During the fiscal year ending June 30, 1900, dredging has been resorted to and previous depths maintained except at one crossing which gave little trouble, owing to favorable stage of water during low-water period. The total amount excavated by the suction dredge was 413,576 cubic yards.

The Port of Portland Commission has operated its 20-inch Bowers dredge during a good portion of the year, and gave valuable aid in maintaining depths to accommodate the large traffic to deep water. They report having expended $67,249.10 and excavation to the amount of 983,249 cubic yards. Only temporary results in way of increased depth were obtained by operations during the fiscal year, as no permanent works were constructed. The maximum draft that can be carried at mean low water over the shoalest part is 18 feet, this being on the bar above Tongue Point.

Comparative statement of traffic.

Calendar year.	Handled by river craft.	Foreign and coastwise to and from Portland.	
		Receipts.	Shipments.
	Tons.	*Tons.*	*Tons.*
1893	1,310,866	....	312,790
1894	1,347,155	52,272	340,792
1895	1,040,022	40,238	395,954
1896	1,129,673	49,011	329,102
1897	1,499,337	47,345	290,412
1898	1,121,161	27,776	488,818
1899	1,489,708	86,253	336,134

July 1, 1899, balance unexpended	$171,569.42
June 30, 1900, amount expended during fiscal year	57,154.44
July 1, 1900, balance unexpended	114,414.98
July 1, 1900, outstanding liabilities	1,787.91
July 1, 1900, balance available	112,627.07
Amount (estimated) required for completion of existing project	2,858,672.93
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	325,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix V V 3.)

4. Columbia River, Oregon, below Tongue Point.—This improvement covers a stretch of the river about 5½ miles long, beginning just below Tongue Point and extending down along the water front of Astoria. The principal obstruction is a rocky point known as the Sylvia de Grasse Reef, about 1 mile below Tongue Point, and around which ships are obliged to make a short turn to avoid striking it. The ledge induces shoaling, with consequent narrowing of the passage.

The original and present project, adopted in 1896 (Annual Report of the Chief of Engineers for 1895, pp. 3605–3608), contemplates the removal of the wreck of the Sylvia de Grasse and the outer portion of the reef, supplemented by dredging to obtain a 25-foot channel 250 feet in width, extending along the water front of Astoria.

The amount expended on this work up to the close of the fiscal year ending June 30, 1899, was $8,507.60. Dredging had been done for temporary relief, but no work had been done toward removal of the reef, and the conditions were practically as previously reported.

During the fiscal year ending June 30, 1900, surveys were made with view of change in project, but after careful consideration it was decided to follow original plan of improvement, and specifications were prepared for doing the work by contract. Preparations are being made for advertising the work.

The maximum draft that could be carried June 30, 1900, at mean low water over the shoalest part of the locality under improvement was about 19 feet.

For commercial statistics see report on Improving Columbia and Lower Willamette rivers, below Portland, Oreg.

July 1, 1899, balance unexpended	$112,492.40
June 30, 1900, amount expended during fiscal year	2,303.78
July 1, 1900, balance unexpended	110,188.62

(See Appendix V V 4.)

5. *Mouth of Columbia River, Oregon and Washington.*—Prior to commencing the work of construction, in 1885, there were from one to three channels across the bar at the mouth of Columbia River, and these channels varied both in location and depth, the latter being usually from 19 feet to 21 feet, while the location shifted through nearly 180 degrees from Cape Disappointment to Point Adams. A map of this locality before improvement is printed in the Annual Report of the Chief of Engineers for 1886, page 1978.

The project for improvement adopted in 1884 (report of Board of Engineers, Annual Report of the Chief of Engineers for 1883, p. 2012 et seq.) contemplated securing a low-water channel depth of 30 feet across the bar at the mouth of the river by the construction of a jetty to extend from the shore near Fort Stevens across Clatsop Spit in the direction of a point about 3 miles south of Cape Disappointment, the jetty to be built of rubble and random blocks of large size, resting upon mattresses of brush.

The method of construction was by hauling out random stone on dump cars over an elevated tramway resting on piles, the rock being dumped as required to bring the jetty to its proper dimensions.

The original project adopted in 1884 provided for a single jetty on the south side of the entrance, built to low-water level and about 4½ miles long. This was modified in 1893 (Annual Report of the Chief of Engineers for 1893, p. 3489 et seq.) to provide for practically a high-tide jetty, in which was included the construction of four low groins built out from the main jetty. The estimated cost of the jetty in the original project was $3,710,000.

The amount expended to June 30, 1899, was $1,965,022.76 (exclusive of the sum of $50,000 authorized by the river and harbor act of June 3, 1896, to be applied to the improvement below Tongue Point), with the result that the jetty was completed in 1895 to the length of 4½ miles and full projected height, with four low-tide groins 1,000 feet, 1,000 feet, 600 feet, and 500 feet long, respectively. Map showing completed work is printed in the Annual Report of the Chief of Engineers for 1895. This work caused an increase in depth over the bar from 20 feet to 31 feet at mean lower low water from 1885 to 1895.

The expenditures during the fiscal year were for the survey for the project of the 40-foot channel, a minor survey of the bar at the close of the fiscal year, for the watching and care of the property and plant belonging to this improvement, and for preparations for repairing the jetty, wharves, and plant with appropriation of June 6, 1900.

Annual surveys since 1896 have shown each year marked shoaling of the depths over the bar, the greatest depth obtained having been 31 feet, in 1895, being one foot in excess of the depth proposed by the original project. The survey completed at the close of the fiscal year 1899 showed that the channel had moved a little farther to the northward and that the least depth on the bar—28 feet at mean lower low water—was one foot less than reported the previous year.

The annual survey of the mouth of Columbia River for the fiscal year ending June 30, 1900, was commenced early in June and completed on June 30. The result of this survey shows a decrease in depths of from 4 to 5 feet, which limits the depth of the channel across the bar to 23 to 24 feet at mean lower low water. This survey, which covers the area lying seaward of the end of the jetty and Cape Disappointment, is shown on tracing submitted herewith. The greatest depth reported the previous year was 28 feet.

In compliance with instructions dated March 15, 1899, a report was submitted by the district officer under date of May 6, 1899, of a preliminary examination of the mouth of the Columbia River with a view of obtaining a channel of 40 feet at lowest low water.

A detailed survey was also made during the year, and report submitted by the district officer under date of November 6, 1899, with project and estimate for deepening the channel; this estimate was $2,531,140.51. This report is printed in House Doc. No. 94, Fifty-sixth Congress, first session, and attention is invited to it for further and complete details and maps of past work; it is also submitted as Appendix V V 12 of this report. The sundry civil act approved June 6, 1900, appropriated $250,000 "For repair to the jetty at the mouth of the Columbia River, Oregon and Washington, including repairs to wharves, approaches, tramway, plant, quarters and buildings, and contingent expenses."

Preparations are being made for resumption of active operations. Rapid extension of the jetty is essential to the success of the improvement, and in view of the importance of this work further appropriations are very necessary, and the work would seem to be one fully justifying them. The balance now available will be applied to making repairs to the jetty, including repairs to wharves, approaches, tramways, plant, etc.

For commercial statistics see report on Columbia and Lower Willamette rivers below Portland, Oreg.

July 1, 1899, balance unexpended	$10,657.24
Amount appropriated by sundry civil act approved June 6, 1900	250,000.00
	260,657.24
June 30, 1900, amount expended during fiscal year	3,730.38
July 1, 1900, balance unexpended	256,926.86
July 1, 1900, outstanding liabilities	1,967.81
July 1, 1900, balance available	254,959.05
Amount (estimated) required for completion of existing project	2,281,140.51
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	600,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V V 5.)

6. *Clatskanie River, Oregon.*—The Clatskanie River rises in the Coast Range and is a tributary of the Columbia, which it enters by means of connecting sloughs at a point on the south bank about 65 miles below Portland.

At the time of the adoption of the present and original project (Annual Report of the Chief of Engineers for 1898, p. 3050) a depth of five feet could be carried to Clatskanie, except over a shoal near the latter place, where but 2 to 3 feet is found. Large quantities of lumber and shingles find a market through this natural outlet. The channel is very narrow and exceedingly winding. Its improvement will be of benefit to those interested.

The project for expenditure of $13,000 (act of March 3, 1899) contemplated cutting a short channel across the bend immediately below Manzanillo, and another from the bend above this point to the first bend below the town of Clatskanie, and by dredging below the latter point, the work to be done by contract. It is expected to secure thereby a depth of 6 feet to the town of Clatskanie, 3 miles from the mouth.

No funds had been expended on field work at the close of the fiscal year ending June 30, 1899. The first appropriation was made by the river and harbor act of March 3, 1899, and on June 30, 1899, no work had been done. During the past year the necessary surveys were made and deeds secured to the necessary land.

Comparative statement of the tonnage carried by river boats on the Clatskanie River for the past four years.

Calendar year.	Merchandise.	Passengers.	Calendar year.	Merchandise.	Passengers.
	Tons.	*Number.*		*Tons.*	*Number.*
1896	117,242	8,460	1898	153,257	12,250
1897	112,803	11,545	1899	68,126	5,210

July 1, 1899, balance unexpended	$13,000.00
June 30, 1900, amount expended during fiscal year	134.11
July 1, 1900, balance unexpended	12,865.89
Amount that can be profitably expended in fiscal year ending June 30, 1902, for maintenance of improvement, in addition to the balance unexpended July 1, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix V V 6.)

7. *Lewis River, Washington.*—The Lewis River rises in the Cascade Range. It is a tributary of the Columbia, drains an exceedingly fertile valley, and enters the Columbia from the north about 14 miles below the mouth of the Willamette, or 25 miles from Portland, Oregon.

At the time of the adoption of the present and original project (Annual Report of the Chief of Engineers for 1897, p. 3475) 4 feet could be carried at low water to the forks, 3½ miles from the mouth, and 2 feet to Lacenter, on the east fork and about 7 miles from the mouth. The channel was obstructed by trees, snags, and occasional shoals. Its improvement will be of benefit to the farmers and the large adjacent lumbering interests.

The project for expenditure of $10,000, the first appropriation for this river (act of March 3, 1899), contemplates, so far as funds will permit, the removal of snags and obstructions, dike and dam work, and dredging with a view of obtaining a depth of 6 feet in the main river to the forks and 4 feet thence to Lacenter.

No funds had been expended at the close of the fiscal year ending June 30, 1899.

During the fiscal year ending June 30, 1900, dredging was done at the mouth of the east fork, snags and trees removed from the channel, and dams constructed at various places. It is anticipated that the work done, which will be continued with available funds, will be of benefit; but the high-water season is now on and will not permit an examination. The maximum draft that can be carried over the shoalest portions, which is between the forks and Lacenter, is probably about 2 feet.

Comparative statement of the tonnage carried by river boats on the Lewis River for the past four years.

Calendar year.	Merchandise.	Passengers.	Calendar year.	Merchandise.	Passengers.
	Tons.	*Number.*		*Tons.*	*Number.*
1896	2,374	12,990	1898	6,303	15,938
1897	3,881	15,306	1899	6,549	12,351

The above does not include large quantities of logs which are annually floated out of this stream.

July 1, 1899, balance unexpended	$10,000.00
June 30, 1900, amount expended during fiscal year	4,284.95
July 1, 1900, balance unexpended	5,715,05

Amount (estimated) required for completion of existing project	10,460.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

See Appendix V V 7.

8. *Cowlitz River, Washington.*—The Cowlitz River rises in the Cascade Range; it is a tributary of the Columbia and flows into it from the north and about 64 miles from its mouth.

Prior to improvement the ruling depth at low water to Toledo, 40 miles above the mouth, was 14 inches. The channel was narrow and tortuous and obstructed by sand bars, numerous snags, drift, logs, etc. The valley is exceedingly fertile, and any improvement of the river is a direct benefit to the farmers who ship great quantities of produce to market by boat.

The original project, adopted in 1880 (report dated December 15, 1879), contemplated the removal of sand bars and other obstructions to a point about 50 miles above the mouth, at a cost of $5,000 for the first year and an annual expenditure thereafter of $2,000 for maintenance.

The amount expended up to the close of the fiscal year ending June 30, 1899, was $27,946.28. At that time the principal obstruction was a bar 1 mile below Toledo, formed by the unusually high water of 1897; to this point 18 inches could be carried at low water and boats could pass it on the high stages. The work yet to be done consists of the construction of dikes and revetments, snagging operations, and the scraping of bars.

The amount expended during the fiscal year ending June 30, 1900. was applied so far as it would permit in constructing two dams at the bar 1 mile below Toledo. Some snagging was also done. The available funds were insufficient to allow comprehensive work to be undertaken, and, aside from a beginning being made, results in way of increased depth are small and undeterminate, as high water now existing prevents determination of low-water depths.

The maximum draft that could be carried at low water to Toledo at the close of the fiscal year was probably about 2 feet.

Comparative statement of traffic.

Calendar year—	Tons.	Calendar year—	Tons.
1894	17,923	1897	17,582
1895	17,940	1898	16,210
1896	14,776	1899	26,511

This statement does not include large quantities of logs that are annually floated down this stream.

July 1, 1899, balance unexpended	$3,053.72
June 30, 1900, amount expended during fiscal year	3,037.22
July 1, 1900, balance unexpended	16.50

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance unexpended July 1, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix V V 8.)

9. *Gauging waters of Columbia River, Oregon and Washington.*—The object of this gauging is to obtain data for use in connection with the improvement of the river and to supply information to persons interested in its navigation.

The self-registering gauge was reestablished at Astoria in November, 1888, where it was kept in operation up to August, 1899, and then moved to Fort Stevens, where it could be more economically maintained. Daily bulletins have been exhibited for the benefit of shipping interests, and in view of the benefit to commerce its maintenance is considered a worthy object.

The amount expended on this work to June 30, 1899, was $6,975.05.

July 1, 1899, balance unexpended	$1,024.95
June 30, 1900, amount expended during fiscal year	221.58
July 1, 1900, balance unexpended	803.37

Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V V 9.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examinations and surveys of the following localities, required by the river and harbor act of March 3, 1899, were made by the local engineer, and reports thereon submitted through the Division Engineer, Col. S. M. Mansfield, Corps of Engineers:

1. *Preliminary examination and survey of canal and locks at Willamette Falls, Willamette River, Oregon.*—Report on preliminary exam-

ination was submitted by Maj. W. L. Fisk, Corps of Engineers, April 30, 1899, and in his opinion, concurred in by the division engineer and by me, the canal and locks are worthy of acquisition by the United States if they can be obtained at a reasonable price. A survey was ordered and a Board of Engineers constituted to consider and report upon the matter. The Board submitted its report November 24, 1899, and stated that the United States would not be justified in acquiring the property unless the total cost shall not exceed, approximately, $456,000. The reports were transmitted to Congress and printed in House Doc. No. 202, Fifty-sixth Congress, first session. (See also Appendix V V 10.)

2. *Preliminary examination and survey of Lower Willamette and Columbia rivers, below Portland, Oreg.*—Report on preliminary examination was submitted by Major Fisk April 6, 1899, and report on survey by his successor, Capt. W. C. Langfitt, Corps of Engineers, April 12, 1900. In the opinion of Major Fisk, concurred in by the division engineer, the locality is worthy of improvement by the General Government, and Captain Langfitt presents a plan for such improvement at an estimated cost of $2,971,300, and $50,000 annually for maintenance. The reports were transmitted to Congress and printed in House Doc. No. 673, Fifty-sixth Congress, first session. (See also Appendix V V 11.)

3. *Preliminary examination and survey of mouth of Columbia River, Oregon and Washington.*—Report on preliminary examination dated May 6, 1899, was submitted by Major Fisk, and report on survey dated November 6, 1899, by Captain Langfitt. The locality is considered by the local officers and the division engineer to be worthy of improvement by the General Government. The plan proposed for improvement is estimated to cost $2,531,140.51. The reports were transmitted to Congress and printed in House Doc. No. 94, Fifty-sixth Congress, first session. (See also Appendix V V 12.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN WASHINGTON, IDAHO, AND MONTANA.

This district was in the charge of Capt. Harry Taylor, Corps of Engineers, having under his immediate orders Lieut. Meriwether L. Walker, Corps of Engineers. Division Engineer, Col. S. M. Mansfield, Corps of Engineers.

1. *Willapa River and Harbor, Washington.*—Willapa Harbor, formerly known as Shoalwater Bay, connects with the Pacific Ocean 28 miles to the north of the entrance to the Columbia River. The only portion of the harbor to which any consideration in the way of improvement has been given is that in the vicinity of South Bend, the principal city of the harbor and the terminus of the railroad from the main line of the Northern Pacific at Chehalis.

South Bend is situated very near the mouth of the Willapa River. Just at the upper limits of the town the river divides itself into a main channel and a secondary channel, the latter known as Mailboat Slough. This division of the waters caused bars to form in the main channel at both the upper and lower ends of the slough. There were also several bars in the river proper between South Bend and Willapa City.

The plan of improvement adopted consists in building a dike of piles, brush, and stone across the head of Mailboat Slough, in order to concentrate the ebbing and flooding currents into the main channel, and thereby produce as great a scour as possible on the shoals at the head and foot of the slough; also to dredge a channel 100 feet wide and 8 feet deep at low water through the reef just below Willapa City, and to close Louderback Slough with a pile, brush, and stone dike, with the object of compelling the currents to scour a channel through the bar in the river at its lower end. The estimated cost of the work is $31,350.

The act of August 18, 1894, authorized the expenditure of not to exceed $2,500 from the appropriation for this improvement for cutting a channel through a log jam in the North River, and the act of March 3, 1899, authorized the expenditure of so much of that appropriation for this improvement as might be necessary to more thoroughly clean this same jam.

The amount expended to June 30, 1899, was $28,022.80, of which $25,522.80 had been expended on Willapa River and Harbor proper and $2,500 on the improvement of the North River.

Up to June 30, 1899, the dike work in the river and harbor and the work of dredging through the shoal just below Willapa City had been completed and the jam in the North River partly cleared away.

During the fiscal year ending June 30, 1900, the dikes were repaired and refilled, and the channel through the North River jam cleaned out and widened to a fairly uniform width of about 85 feet at high water.

The work called for by the project has all been completed. The object of the improvement, so far as to give a channel 8 feet deep at mean lower low water to Willapa City, has been practically accomplished.

The dikes at Mailboat Slough have caused a general deepening of the shoals in their vicinity of about 2 feet, so that the least depth to South Bend, the principal city on Willapa Harbor, is now 15 feet at mean lower low water.

It is believed that the effect of the Mailboat Slough dikes has been about as great as can be expected.

The dikes already built will probably need occasional repairs, but the funds already appropriated will be sufficient to maintain them for many years, as well as to do what little work there is yet to be done on the North River jam.

No recommendation for future appropriations is made

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1894	66,908	$639,280
1895	61,858	705,570
1896	48,960	600,600
Calendar year—		
1896	27,542	351,175
1897	37,815	313,163
1898	32,399	374,050
1899	51,150	755,682

July 1, 1899, balance unexpended	$8,327.20
June 30, 1900, amount expended during fiscal year	3,205.16
July 1, 1900, balance unexpended	5,122.04

(See Appendix W W 1.)

2. *Grays Harbor and bar entrance, Washington.*—The first appropriation for this work was made in the river and harbor act of June 3, 1896.

The entrance to Grays Harbor from the Pacific Ocean lies in latitude 46° 55′ north, being 45 miles north of the mouth of the Columbia River.

The harbor has a length from east to west of 17 miles, and from north to south a maximum breadth of 14 miles. There are a number of rivers tributary to the harbor, the principal ones being the Chehalis, Satsop, Wynooche, Wishkah, Hoquiam, and Humptulips, all of which come from the east and north. There are two main channels crossing the harbor from east to west—the north and south channels—of which the north channel is the principal one, and has been improved.

A large part of the harbor is occupied with tide flats, bare at low water. The total tidal area of the harbor is estimated at 96.8 square miles. At low tide the area covered by water is estimated at 30.6 square miles, or less than one-third of the total area. The average range of the tide is 8.4 feet, with a maximum range of 12.9 feet.

The harbor throat lies between two low sandy peninsulas, which are about 12,500 feet apart, measured between high-tide lines.

Through the harbor throat there is a channel having a maximum depth of 100 feet or more. A single broad waterway extends for more than 2 miles out to sea from the harbor throat, with depths gradually diminishing to 30 feet. Between this deep waterway and the open sea lies a bar convex to the sea and connected with the sand spits on the two sides of the harbor throat.

Across the bar there was no well-defined, decided, permanent channel, but there are several variable shifting channels having depths of about 12 or 13 feet. The general average distance between the inner and outer 18-foot curve is one-half mile.

The proposed plan of improvement is to control, by means of a single jetty extending out to sea from the point on the south side of the harbor throat a distance of about 3½ miles, the ebbing and flooding waters to a sufficient extent to concentrate and direct upon the bar a much greater portion thereof than would naturally go there. It is expected that a depth of 24 feet at mean lower low water will be obtained across the bar.

The jetty is to be of rubblestone built above high-tide level. The estimated cost of the work is $1,000,000.

A full description of this work with plan is published in the Annual Report of the Chief of Engineers for 1895, pages 3517–3528.

The act of June 3, 1896, making the first appropriation for this work, authorized the making of a contract or contracts for the completion of the project. In accordance with this authority a contract for the entire work was entered into after due advertisement. This contract was approved by the Chief of Engineers February 23, 1898, and work under it commenced in March, 1898.

The amount expended to June 30, 1899, was $146,929.91.

At the end of June, 1899, the jetty trestle had been completed 5,152 feet outside the high-water line on the ocean side of the spit, the foundation of the jetty had been completed 4,320 feet outside the high-water line and partially completed 43 feet farther. The enrockment had been completed 1,104 feet outside the high-water line, and more or less rock had been placed from that point to the end of the foundation. The enrockment had been completed to or above the high-water level for a distance of 3,520 feet.

During the fiscal year ending June 30, 1900, the jetty trestle was advanced 2,584 feet, the completed foundation advanced 3,336 feet, and the enrockment completed to the level of ordinary high water for an additional distance of 3,680 feet. At the end of June, 1900, the jetty trestle had been completed 7,736 feet outside the high-water line on the ocean side of the spit, the foundation had been completed 7,656 feet, and enrockment raised to or above the level of ordinary high water 7,200 feet from the shore line.

During the year the following materials were received from the contractor:

49,378 linear feet piling, at 11 cents	$5,431.58
314,968 feet B. M. lumber, at $11 per M	3,464.65
73.6025 tons steel railroad rails and connections, at $40	2,944.10
12,041.7 cubic yards brush, at $1.20	14,450.04
42,240 pounds iron, at 4 cents	1,689.60
140,455.475 tons of stone, at $1.10	154,501.02
Total earned by contractor	182,480.99

On account of the probability of delay by storms and the risk involved construction work was entirely suspended from December 19, 1899, to March 1, 1900. The progress during the year was in advance of the contract requirements.

The authorized limit of cost of this work is $1,000,000. The value of the contract under which the work is being carried on was $769,870, to which were to be added the cost of engineering, inspection, and incidental expenses. During the past year excessive scour has taken place in front of the jetty and along the proposed line of construction, so that more materials will be required than originally estimated. This will bring the cost to the full authorized limit of $1,000,000.

There has been a general deepening of the water across the bar, and at the end of the year there are two channels with a depth of 18 feet at mean lower low water across the bar. At the time the last survey was made in 1898 the controlling depth was 14 feet. A gain of 4 feet is therefore shown.

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1893	298,236	$4,431,748
1894	302,102	3,221,500
1895	159,744	848,591
1896	227,351	1,420,055
Calendar year—		
1896	110,748	629,677
1897	150,908	1,071,747
1898	168,468	1,252,089
1899	265,918	1,979,998

July 1, 1899, balance unexpended		$508,070.09
Amount appropriated by sundry civil act approved June 6, 1900		50,000.00
		558,070.09
June 30, 1900, amount expended during fiscal year		223,089.64
July 1, 1900, balance unexpended		334,980.45
July 1, 1900, outstanding liabilities	$4,455.11	
July 1, 1900, amount covered by uncompleted contracts	450,372.81	
		454,827.92
Amount (estimated) required for completion of existing project		295,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900		295,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W W 2.)

3. *Chehalis River, Washington.*—The portion of the Chehalis River that it is possible to navigate may well be considered in three sections:

1. The tidal section, from the mouth to Montesano, a distance of 15 miles. In this portion there is about 10 feet of water at high tide.
2. From Montesano to Elma, 16 miles, the river is slightly affected by the tides and has in general sufficient depth of water for light-draft boats, but navigation is obstructed by logs and fallen trees, and in summer by a scarcity of water on the bars.
3. Above Elma the river is a succession of shoals and pools, with only 6 to 12 inches of water on the shoals during low water. This part of the river is practically blockaded with snags. With improvement, this river could be navigated above Elma for perhaps four months in the year a distance of 30 miles, and occasional trips made much farther up.

The plan of improvement contemplates the removal of snags, overhanging trees, jams, drift heaps, shoals, and other obstructions to navigation which may from time to time accumulate in the portion of the river regularly used by boats.

The cost of the work is indefinite.

The amount expended to June 30, 1899, was $15,553.39.

The lower section of the river had been cleared of snags from time to time as they accumulated.

During the fiscal year ending June 30, 1900, the river below Montesano was gone over twice and thoroughly cleared of snags each time.

From the nature of the country through which the Chehalis River runs it is liable to be blocked with snags after every freshet. To keep it open and tolerably free from obstructions to navigation it is necessary to go over it at least once a year. Heretofore the work has been almost entirely confined to the portion of the river below Montesano and for the next 4 or 5 miles above, as this portion of the river is that principally navigated. A branch of the Northern Pacific Railway parallels the river, and there is but little demand for any navigation farther up the river than where the work has been done. Even were the river entirely clear of snags above that point, its navigation would be difficult and dangerous on account of the swift current and shallow water. Future work will therefore be confined, as heretofore, to the lower part of the river.

Wing dams at one shoal below Montesano would also be of benefit.

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1895	4,354	$233,691
Calendar year—		
1896	2,561	246,498
1897	2,401	248,387
1898	2,730	293,610
1899	2,282	352,316

July 1, 1899, balance unexpended	$3,446.61
June 30, 1900, amount expended during fiscal year	1,367.70
July 1, 1900, balance unexpended	2,078.91

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix W W 3.)

4. *Puget Sound and its tributary waters, Washington.*—The old title of this appropriation was "Improvement of Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Washington." Under date of August 4, 1892, the change to the new title was approved and all money and property on hand were transferred and thereafter accounted for under the new title.

In their original condition the navigable streams flowing into Puget Sound carried water enough for the purpose of steamer navigation, but were obstructed by snags, fallen trees, and log jams. They were the great highways of the country, travel by land being almost impossible on account of the heavy timber, dense underbrush, and fallen logs.

About their mouths there are in every instance large areas of shallow water with tortuous channels, and these are often obstructed by drift. These shallows act as submerged dams to the rivers, and by preventing the free outflow of their waters indirectly do great damage by inundating the lowlands through which they flow.

The plan of improvement contemplates the removal of snags, logs, trees, and other obstructions to navigation. For this purpose a snag boat with an outfit of tools and appliances has been provided. This boat passes from one river to another, doing service in each as far as the necessities of its commerce require and as the amount of the funds appropriated will admit.

With the funds that have been appropriated this snag boat and outfit have been provided, and a large number of snags, jams, overhanging trees, and other obstructions to navigation removed. The obstructions in the rivers, with those that come in with every freshet, will furnish constant employment for the snag boat for an indefinite period.

The amount expended on the project to June 30, 1899, was $146,757.70.

The snag boat had been built, operated part of the time for fourteen years, rebuilt, and operated continuously for three years.

The rivers had been cleared of their worst obstructions, their navigation greatly improved, and the annual season during which navigation was suspended by reason of obstructions greatly lessened.

The snag boat was kept continuously at work during the fiscal year ending June 30, 1900, and removed during the year 4,726 snags ranging in diameter from 5 inches to 15 feet and having an aggregate length of 130,974 feet, and cut from the banks where they were liable to fall into the stream and become obstructions, 1,153 trees with trunks ranging in diameter from 6 inches to 14 feet and having an aggregate length of 98,253 feet. Two small ditches were dug across projecting points on the Skagit River, and these becoming enlarged by freshets, new straight channels were formed and dangerous cutting of the banks stopped.

As a result of the snagging operations during the year the Skagit River was kept open for navigation during the year and its navigation at all seasons greatly improved, and the navigation of the other streams where work was done improved.

The work which has been done on the rivers flowing into Puget Sound has been confined to those which flow into it from the east. These streams all have their sources in the mountains, which are covered with a heavy snowfall in the winter. The upper parts of the streams are in the nature of mountain torrents, subject to rapid fluctuations. The lower parts of the rivers have a flat slope, run through a country which was formerly completely, and is still partially, covered with heavy forests, and they generally empty into Puget Sound through a number of mouths, forming wide deltas. These conditions favor the rapid accumulation of snags and drift in the lower parts of the rivers. It is of great importance to keep these snags out for the safety of navigation and to prevent the outlets becoming completely blocked and causing disastrous overflows. To do this, it is necessary that the snag boat should be kept steadily at work.

Previous to 1896 there had never been sufficient money to permit of this being done, and the work accomplished has simply been to remove those snags which most interfered with navigation. During the past three years, the available funds having been sufficient to permit it, the snag boat has been kept continuously at work, with the result that the rivers worked on are now in better condition than they have been for many years.

Boats now run the Skagit River at night with comparative safety, where three years ago it was dangerous to run by daylight.

There is still work enough in sight to keep the snag boat busy for a couple of years, and with what new snags come in it will be an indefinite time before the rivers will be entirely clear.

The continued snagging operations are absolutely necessary for the protection of the country adjacent and the navigation of the rivers, and for these operations alone an appropriation of $25,000 is necessary, and this amount is recommended.

Exports and imports.

Calendar year.	Tons.	Value.
1896	18,600	$358,600
1897	11,922	325,280
1898	12,676	539,406
1899	18,500	577,586

July 1, 1899, balance unexpended	$46,742.30
June 30, 1900, amount expended during fiscal year	14,020.43
July 1, 1900, balance unexpended	32,721.87
July 1, 1900, outstanding liabilities	2.38
July 1, 1900, balance available	32,719.49
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix W W 4.)

5. *Harbor at Olympia, Wash.*—Olympia is situated at the head of Budd Inlet. The upper end of this inlet is shoal. The shoals extend from the heart of the city, at Fourth Street Bridge, for a distance of 8,750 feet, to a depth of 12 feet at mean lower low water in Budd Inlet. These shoals necessitated the building of long wharves out to deep water, the maintenance of which, due to the ravages of the teredo, was very expensive. The alternative of this, i. e., boats coming and going only at high tide, caused great inconvenience.

It is proposed by the plan of improvement adopted to dredge a channel 250 feet wide and 12 feet deep at the mean of the lower low waters from the vicinity of the Fourth Street Bridge to deep water in Budd Inlet. Near its inner end the channel is to be widened out to 500 feet, so as to provide a turning basin for boats using it.

The estimated cost of the work is $147,000.

The amount expended to June 30, 1899, was $104,876.05. The turning basin had been completed and the channel had been dredged its full width to a depth of 10 feet at mean lower low water for a distance of 1,500 feet from the outer end and to a depth of 8 feet at mean lower low water for the remainder of its length.

During the fiscal year ending June 30, 1900, the channel was dredged to the full depth of 12 feet at mean lower low water for a width of 150 feet throughout its entire length and to its full width of 250 feet for part of its length.

The importance of Olympia has heretofore been more on account of its being the capital of the State than on account of its commerce. The greater part of the commerce carried on by water has been the local commerce between Olympia and other cities on Puget Sound. This local traffic is carried by the ordinary light-draft stern-wheel boats, and the depth and width of channel and basin already secured are ample for the accommodation of this class of boats. During the past two years considerable lumber has been shipped by water, and a very material increase in the marine traffic of Olympia may be looked for in the near future. The mills making lumber shipments by water are not on nor adjacent to the improved channel, so that no extension of the present project would benefit this class of commerce.

Some shoaling of the channel already dredged may be expected, and to remove this and complete the project it is estimated that $25,000 will be required, which should all be appropriated at one time.

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1893	95,011	$2,067,825
1894	55,148	421,225
1895	25,125	239,400
1896	28,480	266,700
Calendar year—		
1896	36,099	191,300
1897	29,800	430,900
1898	52,335	1,208,226
1899	42,694	1,173,684

July 1, 1899, balance unexpended	$17,123.95
June 30, 1900, amount expended during fiscal year	17,007.20
July 1, 1900, balance unexpended	116.75
July 1, 1900, outstanding liabilities	1.92
July 1, 1900, balance available	114.83
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix W W 5.)

6. *Waterway connecting Puget Sound with Lakes Union and Washington.*—The river and harbor act of September 19, 1890, contained an item directing the appointment of a Board of three officers of the Corps of Engineers, upon whom should devolve the duty of selecting and surveying the most feasible location and of estimating the expense of constructing a ship canal to connect the waters of Lakes Union, Washington, and Samamish with Puget Sound, and appropriated $10,000 for the necessary expenses. The report of this Board is contained in House Ex. Doc. No. 40, Fifty-second Congress, first session, and also in the Annual Report of the Chief of Engineers for 1892, page 2762 et seq.

Since the original estimates of the cost of this improvement were made several changes in the plan have been adopted, all of which materially affect the cost, but owing to provisos attached to the two appropriations already made for this work, that none of the money appropriated should be expended until the entire right of way and a release from all liability to adjacent property owners should have been secured to the United States free of cost, it has not been practicable till now to undertake the preparation of detailed plans and estimates of cost. To comply with these restrictions of law King County, in which the canal is located, has obtained the right of way and release from liability and deeded the same to the United States. All preliminary steps having been satisfactorily completed, the deed to the right of way and the release from liability was accepted by the United States and filed for record June 22, 1900. Detailed plans and estimates of cost will be prepared as soon as practicable, and work of construction will be commenced with the funds available at an early day.

The approved project for this work contemplates the construction of a ship canal from the waters of Puget Sound, through Salmon Bay, to Lake Union, and thence to Lake Washington. It includes dredging through the flats immediately outside of Salmon Bay to a lock in the lower end of Salmon or Shilshole Bay, the construction of this lock, dredging inside of the lock through Salmon Bay, and the digging of a canal from the upper end of Salmon Bay to Lake Union; also dredging to the eastern end of Lake Union and the construction of a canal between Lakes Union and Washington.

This general project and route, based upon the report of the Board of Engineers above mentioned, was recommended by a second Board of Engineers in a report submitted March 23, 1898, and approved by the Secretary of War April 14, 1898.

The channel depth and dimensions of the lock considered by the Board of Engineers in 1891 were such as appeared to be required to satisfy the needs of the then existing and immediately prospective commerce, and the necessity for a future increase in dimensions was contemplated.

In appropriating for the work in 1894 and 1896 Congress has provided for commencing construction of "a ship canal with the necessary locks and appliances." No restrictions as to dimensions are made, and it is understood that the dimensions to be provided are such as will accommodate the interests to be served.

In October, 1897, as a result of certain correspondence between the Secretary of War and the Secretary of the Navy, the former expressed the opinion that this ship canal should be of sufficient size to accommodate the largest class of war vessels; this would require a width of not less than 90 feet and a depth of 30 feet.

In the opinion of the officer in local charge of the work the least dimensions that will accommodate all the classes of vessels likely to use the canal are, for the lock, 800 feet length; net width, 100 feet; depth at sill, extreme low stage, 22.6 feet, which is required to pass vessels of 30-foot draft at lowest high water. Outside of the lock the channel should be 300 feet wide at the lowest high tide, with a basin at the outlet of the lock 1,000 feet long and 32 feet deep at extreme low tide, and a corresponding depth for the canal inside the lock.

It will be understood that the dimensions given are approximate, and when complete plans are developed it may be necessary to modify them somewhat.

The amount expended to June 30, 1899, was $5,000, and at that date a cadastral survey of the right of way and overflowed lands had been made.

There was nothing expended during the fiscal year ending June 30, 1900, and no work was done by the United States.

Exports and imports.

Calendar year.	Tons.	Value.
1897	563,901	$19,114,111
1898	804,867	32,665,856
1899	832,942	33,068,012

July 1, 1899, balance unexpended	$170,000.00
July 1, 1900, balance unexpended	170,000.00
Amount (estimated) required for completion of existing project	(1)
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W W 6.)

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[1] Final estimate not yet prepared.

7. *Everett Harbor, Washington.*—Everett is situated on a peninsula, one side and the end of which are bounded by the Snohomish River and the other side by the waters of Puget Sound. Of the water front on Puget Sound but a small part has deep water; the remainder fronts on the tide flats which have been formed by the Snohomish River.

A portion of the river forming the rear or fresh-water boundary of the peninsula has navigable depths sufficient for all ordinary purposes of commerce, but below this, and especially across the tide flats at the mouth, the water is shallow, and great difficulty is experienced in getting into the fresh-water river harbor back of the city.

The plan of improvement adopted for this work may be generally described as follows:

First, to excavate a harbor basin in the shallows and tide lands adjoining deep water near the river's mouth; second, to dredge a channel from this through the tide flats and the Old River mouth to deep fresh water in the Snohomish River, this channel being designed to bring fresh water to the harbor basin and to afford facilities for navigation about the peninsula and into the deep water bounding the peninsula on the east; and third, to protect and maintain this harbor and channel across the tide flats by a bulkhead interposed between them and the open waters of the sound, the bulkhead to act as a retaining wall for the material dredged from the harbor.

The estimated cost of the improvement is $372,000.

The amount expended on the project to June 30, 1899, was $29,934.73.

At that date a dike for the purpose of retaining the dredged material had been built from the lower end of Smiths Island along the established bulkhead line for a distance of 14,436 feet, and a channel, 50 feet wide at the bottom and 6 feet deep at mean low water, dredged from the deep water on the outside in toward the deep water in the river for a distance of 2,885 feet.

During the fiscal year ending June 30, 1900, a continuing contract for the completion of the project was made. No work was done under this contract, as the contractor's plant was not entirely completed at the end of the year.

Until the improvement is practically completed no material benefit will be derived from it, as sand flats which rise several feet above mean low water extend entirely across the proposed channel so that no boats of any kind can use the channel at or near that stage.

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1895	79,919	$1,845,282
1896	144,541	2,724,789
Calendar year—		
1896	210,547	5,384,831
1897	74,960	2,974,526
1898	55,460	2,545,054
1899	42,718	1,477,120

July 1, 1899, balance unexpended	$50,065.27
Amount appropriated by sundry civil act approved June 6, 1900	135,000.00
	185,065.27
June 30, 1900, amount expended during fiscal year	4,199.29
July 1, 1900, balance unexpended	180,865.98
July 1, 1900, amount covered by uncompleted contracts	223,955.00
Amount (estimated) required for completion of existing project	90,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	90,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix W W 7.)

8. *Swinomish Slough, Washington.*—Swinomish Slough is a tidal slough connecting the waters of Saratoga Passage and Skagit Bay on the south with Padilla Bay on the north. It is an important water highway, furnishing the most easterly, the shortest, and safest route for the smaller class of steamboats between the northern and southern waters of Puget Sound. It skirts the Skagit Delta, the richest and most extensive agricultural region of western Washington. It is, however, shallow and crooked in some portions, and the approaches to it are across the shallow flats of Padilla Bay on the north and Skagit Bay on the south.

Swinomish Slough is the ordinary meeting place of the tides, although at times the tides run in one direction entirely through.

The ordinary rise and fall of the tides in the slough is about 8 feet. As a general thing throughout the slough there was an abundant depth of water.

Where the slough widens out, especially where the Indians have been in the habit of putting fish traps, this depth decreased so that there was not over 2 feet at low water in any practicable channel. What channel there was was very crooked.

At the northern end the slough opens out into the flats forming the southern portion of Padilla Bay, in the midst of diked land and marshes.

At the southern end of the slough there were two passages connecting the slough with the waters of Skagit Bay. These passages were separated by a rocky island called McGlinns Island.

The east passage was wide and shallow, having nowhere more than 2 feet depth at low water. The west passage between McGlinns and Fidalgo islands was at the narrowest place 220 feet wide, with an ample depth of water for all purposes.

This short and crooked passage was so situated with high rocky bluffs on either side that one could not see through from one end to the other. On account of its character it had received and was known by the very descriptive title of the "Hole in the Wall."

This is the passage used exclusively by steamers.

Between the "Hole in the Wall" and deep water in Saratoga Passage there were extensive flats which were almost bare at low water.

The plan of improvement adopted is to dredge a channel 4 feet deep and 100 feet wide from deep water in Saratoga Passage across Skagit Flats, through the shoals of the slough proper, and across the flats of Padilla Bay to deep water, and to build dikes in Skagit and Padilla bays to direct the ebbing and flooding waters through the dredged channels.

The estimated cost of this work is $122,000.

A report of a survey of Swinomish Slough upon which the plan of improvement is based is printed with a general map in House Ex. Doc. No. 31, Fifty-second Congress, first session, and reprinted without map in the Annual Report of the Chief of Engineers for 1892, pages 2753–2762.

Maps showing parts of the improvement are also published in the Annual Report of the Chief of Engineers for 1894, opposite page 2615, and for 1896, opposite page 3377.

The amount expended to June 30, 1899, was $74,877.26.

At that date a wattled-pile dike 6,166 feet long had been constructed from a point 400 feet west of the entrance to the "Hole in the Wall" westerly to a point 300 feet distant from the northwest point of Goat Island, a dike consisting of a single row of piles had been built between Goat and Ika islands, and a pile, brush, and stone dike 2,745 feet long had been built between McGlinns Island and Gallahers Point. The wattled dike having shown signs of weakness at exposed points, 2,129 feet of it had been strengthened by adding a second row of piles, and filling in between the two rows with brush and stone. The remainder of the dike had been thoroughly repaired. A channel 100 feet wide at the bottom and 4 feet deep at mean low water had been dredged parallel to and 75 feet from the wattled dike for a distance of 6,120 feet, and across the tide flat just inside the "Hole in the Wall" between McGlinns Island and Laconner, and from Laconner north about halfway to the northern end of the slough. Boats drawing 4 feet can now reach Laconner from the south at mean low water, but not to exceed 2 feet can be carried through the slough.

During the year ending June 30, 1900, 1,357 feet of the dike between the "Hole in the Wall" and Saratoga Passage was repaired and strengthened by the addition of a second row of piles and filling in with brush and stone, making a total of 3,486 feet of this dike that has been thus repaired; a dike 630 feet long was built just inside the "Hole in the Wall," and the dike between McGlinns Island and Gallahers Point was repaired. The result has been to straighten and deepen the channel at some points where the damaged condition of the dikes had allowed it to deteriorate.

As no work has been done on the northern part of the slough, no increase of depth over the original condition has been obtained for through traffic. The work already done has made it very much easier and safer for steamers to reach Laconner, the principal shipping point from the south. Two very short shoals limit the draft that can be carried in to Laconner to 2 feet at mean lower low water. Except for these two short stretches the projected depth of 4 feet at mean lower low water can be carried from Saratoga Passage in past Laconner and part way through toward the north end.

The route through Deception Pass and around the west side of Fidalgo Island is a particularly dangerous one, as the island is high and cuts off the wind to such an extent that a severe wind may be blowing outside and but little intimation of it be felt on the inside. At certain stages the tide running through Deception Pass resembles a mountain torrent more than a tidal flow. On the ebb this tide running into a west wind raises a dangerously heavy sea. A boat once started through the pass can not turn back, but must go through and meet whatever sea there may be on the outside.

It is therefore very desirable that the slough be fully opened with the least delay practicable.

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1893	55,700	$1,510,000
1894	64,050	1,687,000
1895	114,917	1,718,020
1896	181,370	1,709,700
Calendar year—		
1896	65,375	1,347,664
1897	64,497	1,190,000
1898	19,625	832,345
1899	76,636	2,028,454

With the funds on hand and such additional funds as may be appropriated it is proposed to carry on the work outlined in the original project. This will include dredging in Padilla Bay and in the slough proper, dike construction in Padilla Bay, dike repair in Skagit Bay, and the redredging of the channels which may have shoaled. The work yet to be done according to the original estimate includes 6,000 linear feet of dike in Padilla Bay, 6,000 linear feet of dike in the slough proper, 90,000 cubic yards of dredging in Padilla Bay, and 30,000 cubic yards of dredging in the slough proper. Some of the channels which have heretofore been dredged have shoaled, and the dikes which have been built have deteriorated so as to need additional repairs.

July 1, 1899, balance unexpended	$20,122.74
June 30, 1900, amount expended during fiscal year	15,531.67
July 1, 1900, balance unexpended	4,591.07
July 1, 1900, outstanding liabilities	9.86
July 1, 1900, balance available	4,581.21

Amount (estimated) required for completion of existing project	47,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, for works of improvement and for maintenance, in addition to the balance available July 1, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.	

(See Appendix W W 8.)

9. *Okanogan River, Washington.*—The first appropriation for this work was made by the river and harbor act of March 3, 1899. The Okanogan River has a general width of 300 to 400 feet through its entire length, and as a rule has sufficient depth for light-draft navigation throughout the year, but it is obstructed in places by shoals and rocks which prevent any navigation except during the summer high water. The upper stretches are also obstructed by snags.

The plan of improvement contemplates rock removal, the construction of wing dams, and snagging.

Descriptions of the river and the plan of improvement are given in the Annual Report of the Chief of Engineers for 1898, page 3121.

There had been no expenditures up to June 30, 1899.

During the fiscal year ending June 30, 1900, active operations were carried on from August 24, 1899, to April 24, 1900. The entire lower half of the river from the mouth to Johnson Creek, a distance of 40½ miles, was gone over and work done at 18 different places where obstructions existed. During the progress of the work 51 large rocks were blasted and 3,907 bowlders removed from the channel and 675 linear feet of wing dam built, making the river navigable at a stage about one foot lower than it was before, thus increasing the length of the season of navigation and making it more easily navigable at all stages.

The country adjacent to the Okanogan River is rapidly developing and filling up with settlers, and it is important that the improvement should be completed as early as practicable. For this reason it is recommended that the balance of the funds required to complete the improvement be appropriated at one time.

Exports and imports.

Year.	Tons.	Value.
1899	1,733	$151,415

July 1, 1899, balance unexpended	$15,000.00
June 30, 1900, amount expended during fiscal year	12,874.37
July 1, 1900, balance unexpended	2,125.63
July 1, 1900, outstanding liabilities	42.13
July 1, 1900, balance available	2,083.50
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W W 9.)

10. Pend Oreille River, Washington.—The first appropriation for this work was made in the river and harbor act of March 3, 1899. The Pend Oreille River from Lake Pend Oreille down to Priest River has unobstructed low depths of upward of 25 feet, and from Priest River to Albany Falls sufficient depth for river boats. Albany Falls totally obstructs navigation. Below Albany Falls there is sufficient depth for light-draft navigation as far as Box Canyon, about 100 miles, but it is somewhat interfered with by shoals and isolated rocks. Navigation is entirely prevented from passing through Box Canyon by swift currents passing over submerged rocks and by projecting rocky points.

The plan of improvement contemplates the improvement of Box Canyon by the removal of submerged rocks and the blowing off of projecting rocky points, and the removal of submerged rocks between Box Canyon and Albany Falls.

Descriptions of the river and the plan of improvement are given in the Annual Report of the Chief of Engineers for 1898, page 3124.

There had been no expenditure up to June 30, 1899.

During the fiscal year ending June 30, 1900, active operations were carried on during part of August, all of September, October, and

November, and part of December, 1899, with the result of partly clearing away the obstructions in Box Canyon. The amount of rock removed was 7,950 cubic yards.

The work during the fiscal year resulted in little or no benefit to navigation, and on account of the character of the improvement no benefit is to be expected until the improvement is completed.

The work is located in an isolated locality, with which the only means of communication is by the boats plying on the river. The balance of the work on this improvement must be done during the low-water season in the winter when the river is frozen. To prosecute this work a party must be sent in late in the fall, fully prepared in every way to spend several months without any communication with the outside world.

Exports and imports.

Year.	Tons.	Value.
1899	2,617	$129,677

July 1, 1899, balance unexpended	$10,000.00
June 30, 1900, amount expended during fiscal year	8,739.71
July 1, 1900, balance unexpended	1,260.29
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W W 10.)

11. Kootenai River, Idaho, between Bonners Ferry and the international boundary line.—The portion of the Kootenai River for which this appropriation is available is about 60 miles in length, has a gentle current, and a depth sufficient for navigation, but was obstructed by many snags which had lodged in the river.

A description of this part of the river is published in the Annual Report of the Chief of Engineers for 1893, pages 3456–3458.

The plan of improvement is to remove the snags in the river and the leaning trees on the banks which are liable to fall in and become obstructions. The estimated cost of the improvement is $5,000.

The amount expended to June 30, 1899, was $4,254.54.

The entire stretch of river included within the limits of the project had been gone over and cleared of snags.

No work was done nor expenditures made during the fiscal year ending June 30, 1900.

At the time snagging operations were suspended the channel had been practically cleared of snags, but from the nature of the stream and the surrounding country it is certain that other snags will accumulate with every high water. The balance of the appropriation will suffice for only one more general clearing out of the channel and in a few years the stream will again be filled with snags. With the advent of the railroads the importance of this part of the Kootenai River as a navigable stream has greatly diminished, and only an occasional boat now plies on this stream, and such boats as there are are all of British register.

As the appropriations amount to the estimated cost of improvement, no recommendation is made in regard to future appropriations.

Exports and imports.

Calendar year.	Tons.	Value.
1896	1,600	$42,815
1897	2,212	49,025
1898	....	40,699
1899	....	80,508

July 1, 1899, balance unexpended	$745.46
July 1, 1900, balance unexpended	745.46

(See Appendix W W 11.)

12. *Flathead River, Montana.*—The portion of the Flathead River included within the limits for which this appropriation is available is about 27 miles in length. This portion of the river is of very gentle slope, running with many turns through a large area of low-lying lands, and has a minimum depth of about 10 feet, but is obstructed by a large number of snags which have accumulated in the river.

The plan of improvement is to remove the snags.

No estimate of the cost of this improvement has been made, and from its nature none can be made.

A description of this work is given in the Annual Report of the Chief of Engineers for 1895, pages 3480–3484.

The amount expended to June 30, 1899, was $8,042.51.

There were no operations during the fiscal year ending June 30, 1900. The only expenditures were for payments for and care of plant.

The entire stretch of river embraced within the limits of the project has been well cleared of snags. The funds on hand will suffice for one more general clearing of the river, and as snags will accumulate after a rise in the river, further appropriations will be necessary if the river is to be kept clear.

Exports and imports.

	Tons.
1898	78
1899	368

July 1, 1899, balance unexpended	$1,957.49
June 30, 1900, amount expended during fiscal year	477.00
July 1, 1900, balance unexpended	1,480.49
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance unexpended July 1, 1900	2,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, of section 7 of the river and harbor act of 1899, and of sundry civil act of June 4, 1897.

(See Appendix W W 12.)

EXAMINATION AND SURVEY OF NEAH BAY, WASHINGTON, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT APPROVED MARCH 3, 1899.

The preliminary examination and survey of *Neah Bay, Washington*, required by the river and harbor act of March 3, 1899, were made by the local engineer, Capt. Harry Taylor, Corps of Engineers, and reports thereon, dated April 27 and December 30, 1899, respectively, submitted through the Division Engineer, Col. S. M. Mansfield, Corps of Engineers. The locality is deemed by Captain Taylor to be worthy of improvement by the General Government and he presents a plan for improvement at an estimated cost of $1,111,907.50; but the division engineer, while concurring in the opinion of the local officer as to the worthiness of the improvement, proposes a different plan, at an estimated cost of $1,873,154. The reports were transmitted to Congress and printed in House Doc. No. 337, Fifty-sixth Congress, first session. (See also Appendix W W 13.)

EXAMINATIONS REQUIRED BY EMERGENCY RIVER AND HARBOR ACT APPROVED JUNE 6, 1900.

The local officer was also charged with the duty of making preliminary examinations of the following localities, required by the emergency river and harbor act of June 6, 1900, and, if possible, reports thereon will be submitted in time for transmission to Congress at its next session:

1. *Kootenai River between Jennings, Montana, and the international boundary line, with a view to removing obstructions to navigation.*
2. *Tacoma Harbor, Washington.*

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations, surveys, and contingencies of rivers and harbors an appropriation of $200,000 should be made, as follows:

> For examinations, surveys, and contingencies, and for incidental repairs for rivers and harbors, for which there may be no special appropriation; for all expenses connected with the inspection of bridges reported as obstructions to navigation, with the service of notices required in such cases, with the location of harbor lines under the act of March 3, 1899; and for expenses connected with the examinations and reports by officers of the Corps of Engineers and by Boards of Engineers upon plans for bridges authorized by law to be built, and upon bridge bills, reports on which may be called for by Congress, $200,000.

SUPERVISION OF THE HARBOR OF NEW YORK.

The supervisor of the harbor during the year was Lieut. Commander John C. Fremont, United States Navy.

The office of supervisor of the harbor of New York was created by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses." This act has been amended by section 3 of the act of August 18, 1894, entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," by which amendment the functions and powers of the officer have been greatly enlarged. Additional duties are also conferred on the supervisor by section 2 of the last-named act.

Under the provisions of section 5 of the act of June 29, 1888, a line officer of the Navy is designated to discharge the duties created by the act under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

The report of Lieutenant-Commander Fremont for the fiscal year ending June 30, 1900, is submitted as Appendix XX. The report gives a detailed and most interesting description of the important duties performed under the direction of the supervisor of New York Harbor, and makes recommendations as to further legislation desirable in the interests of the work being performed.

Estimates for the fiscal year ending June 30, 1902.—The estimates of funds required for this service for the fiscal year ending June 30, 1902, is given in the above-mentioned report, as follows:

For pay of inspectors, deputy inspectors, office force, and expenses of office.	$10,260
For pay of crews and maintenance of five steam tugs and three launches ...	58,340
For electric plant and steam steering gear and installing same and generally overhauling and repairing steam tug *Nimrod*	4,200
Total	72,800

MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission, constituted by act of Congress of June 28, 1879, is in charge of the improvement of the Mississippi River from Head of Passes to the mouth of the Ohio River, including the rectification of Red and Atchafalaya rivers at their junction with the Mississippi, the building of levees, and the improvement of the several harbors for which specific appropriations have been made, with the exception of the harbor of Vicksburg and the mouth of Yazoo River. It is also charged with the survey of the Mississippi River from Head of Passes to its head waters.

The Commissioners during the past fiscal year were: Col. G. L. Gillespie, Corps of Engineers, president; Lieut. Col. Amos Stickney, Corps of Engineers; Maj. Thomas H. Handbury, Corps of Engineers; B. M. Harrod, Robert S. Taylor, Henry L. Marindin, assistant, United States Coast and Geodetic Survey, and J. A. Ockerson.

The report of the Commission upon the operations under its charge during the fiscal year ending June 30, 1900, is submitted as Appendix Y Y.

The work of the Commission is carried on under "the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission, as approved by the Chief of Engineers," and the work contemplated by law is the general improvement of the river, the building and repairing of levees, and surveys, the "improvement, surveys, building, and repair of levees to be made and carried on in such manner as in their opinion shall best improve navigation and promote the interests of commerce at all stages of the river."

The project of the Commission adopted in January, 1896, contemplates the building of levees, the annual dredging of channels through the shoal places, and such minor bank work as may be necessary for the prevention of cut-offs, and the protection of harbors and threatened levee lines of exceptional importance.

Memphis Harbor, Tennessee.—The river and harbor act approved March 3, 1899, provided for an examination of Memphis Harbor to be made by the Mississippi River Commission, and directed that report be made as to what improvement, if any, should be made to remove the bar in front of the city of Memphis, together with the cost thereof. The report thus called for was submitted by the Commission in its last annual report, and may be found printed on page 3292 et seq. of the Annual Report of the Chief of Engineers for 1899.

The emergency river and harbor act approved June 6, 1900, provided for preliminary examination and survey of the Mississippi River between the highlands near the city of Hickman, in the State of Kentucky, and Slough Landing, in Lake County, in the State of Tennessee, with a view to constructing such works as may be required to prevent overflows along said section of the river, such examination and survey to be made under the direction of the Mississippi River Commission. It is expected that the report thereon will be submitted in time for transmission to Congress at its next session.

Estimates for the fiscal year ending June 30, 1902.—The following estimate of funds required for carrying on the works under its charge for the year ending June 30, 1902, is submitted by the Commission:

For continuing the improvement of the Mississippi River from Head of Passes to the mouth of the Ohio River, including salaries and clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	$3,000,000
Improving harbor at New Madrid, Mo	20,000
Protection of banks at or near Caruthersville, Mo	50,000
Improving harbor at Memphis, Tenn	100,000
Improving harbor at Memphis, Tenn. (at Wolf River)	30,000
Improving harbor at Helena, Ark	20,000
Improving harbor at Greenville, Miss	50,000
Protection of banks at Delta Point, La	120,000
Improving harbor at Natchez, Miss., and Vidalia, La	150,000
Rectification of Red and Atchafalaya rivers, Louisiana	50,000
Improving harbor at New Orleans, La	300,000
Total	3,890,000

MISSOURI RIVER COMMISSION.

The Missouri River Commission, constituted by act of Congress of July 5, 1884, is in charge of the improvement and surveys of the Missouri River below Sioux City, Iowa.

The Commissioners during the past fiscal year were: Lieut. Col. Amos Stickney, Corps of Engineers, president; Maj. Thomas H. Handbury, Corps of Engineers; Maj. W. L. Marshall, Corps of Engineers; Garland C. Broadhead, and C. L. Chaffee.

The river and harbor act of August 18, 1894, in making appropriations for improvement of Gasconade and Osage rivers, Missouri, provided that the funds should be expended by the Missouri River Commission, and the work of improving these streams has since been carried on under its direction.

The report of the Commission upon operations under its charge during the fiscal year ending June 30, 1900, is submitted as Appendix Z Z.

The systematic plan under which the Commission is working, to such an extent as the appropriation acts permit, is that of the permanent improvement of the river in reaches, commencing at the lowest reach, as provided for by law. It is only by the application of appropriations to such systematic work that the improvement of the Missouri River can be accomplished. Allotments from the appropriations for work in detached localities can do but little good at such points, and all such allotments interfere materially with the progress of the systematic improvement, increase its cost, and postpone the time when commerce will commence to reap full benefit from the improvement. In fact, it can be stated that unless the appropriations for this river can be so made as to permit its expenditure for the systematic improvement of the river rather than to require subdivision and expenditure in many special localities, the appropriation might as well be omitted so far as the interests of navigation are concerned. If the systematic improvement is to continue in the interest of navigation and commerce, the annual general appropriation should be used only on such systematic improvement, and any detailed localities which it is desired to have protected or improved should be provided for by special appropriations for such localities.

Estimates for the fiscal year ending June 30, 1902.—The following estimate of funds required for carrying on the works under its charge for the year ending June 30, 1902, is submitted by the Commission:

Improving Missouri River from mouth to Sioux City, Iowa, including office and traveling expenses and salaries of commission, surveys, gauges, physical data and publications, operating snag boat, and systematic improvement of first reach		$1,000,000
Improving Osage River, Missouri:		
For works of improvement	$20,000	
For maintenance of improvement	5,000	
		25,000
Improving Gasconade River, Missouri:		
For works of improvement	10,000	
For maintenance of improvement	5,000	
		15,000
		1,040,000

CALIFORNIA DÉBRIS COMMISSION.

Act of Congress approved March 1, 1893, provided for the establishment of the California Débris Commission, to consist of three officers of the Corps of Engineers, appointed by the President, with the concurrence of the Senate, whose functions relate to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems in California. The Commission is empowered and required to adopt plans for improving the navigation of the rivers in the systems mentioned, to project and construct works for impounding detritus and preventing the deterioration of the rivers from the deposit of hydraulic mining and other débris, and to devise means and issue permits for resuming and carrying on hydraulic mining operations under conditions that will not injure other interests in the State. The powers of the Commission, methods of procedure, etc., are prescribed in the act in detail.

The Commissioners during the past fiscal year were Col. S. M. Mansfield, Lieut. Col. W. H. Heuer, and Capt. Herbert Deakyne, Corps of Engineers.

During the year the Commission has permitted hydraulic mining to be carried on subject to the restrictions imposed by law, and has matured and submitted a plan (printed in House Doc. No. 431, Fifty-sixth Congress, first session, and also submitted as a part of Appendix A A A of this report) for the construction of a system of works in the Yuba River designed to protect the Sacramento and Feather rivers from injury by the débris now in the Yuba.

The report of the Commission upon its operations during the fiscal year ending June 30, 1900, is submitted herewith as Appendix A A A.

Estimate for the fiscal year ending June 30, 1902.—The Commission submits an estimate of $15,000 as the amount required for payment of the necessary expenses connected with the work under its charge during the fiscal year ending June 30, 1902.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Plans and maps of locations of the following bridges, proposed to be erected under the authority of special acts of Congress, have been examined, with a view to protection of the interests of navigation, and have been approved by the Secretary of War, as provided by the acts; and the local engineer officers have been furnished with copies of the instruments of approval and drawings showing plans and locations, and charged with the supervision of the construction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. *Bridges of Escambia County, Ala., across Conecuh River at Hendleys Ferry, near Brewerton, and at Parkers Ferry.*—The construction of these bridges was authorized by act of Congress approved March 2, 1899. Plans and maps of location were submitted September 19, 1899; approved by the Secretary of War October 16, 1899.

2. *Bridge of the Rutland-Canadian Railroad Company across Lake Champlain between Alburg, Vt., and Champlain, N. Y., at Rouse Point.*—Plans and map of location of this bridge, proposed to be built under authority of act of Congress approved February 4, 1899, were submitted November 29, 1899; approved by the Secretary of War February 10, 1900.

3. *Bridge of the Union Railroad Company across Monongahela River between Mifflin and Rankin, Pa. (at Carrie Furnaces).*—The construction of this bridge was authorized by act of Congress approved March 2, 1900. Plans and map of location were submitted January 31, 1900; approved by the Secretary of War March 10, 1900.

4. *Bridge of the city of Drayton, N. Dak., across Red River of the North.*—Plans and map of location of a bridge proposed to be constructed at this place under authority of an act of Congress approved February 28, 1900, were submitted March 30, 1900; approved by the Secretary of War April 18, 1900.

5. *Bridge of Mr. Frank Hitch across Fishing Creek, North Carolina.*—The construction of this bridge was authorized by act of Congress approved March 1, 1900. Plans and map of location were submitted January 12, 1900; approved by the Secretary of War April 30, 1900.

6. *Bridge of the city of Cambridge, Mass. (West Boston Bridge), across Charles River between Boston and Cambridge, Mass.*—By act of Congress approved March 29, 1900, a drawless bridge was authorized to be constructed at this locality, to replace the existing structure, and plans for such a bridge were submitted May 26, 1900; approved by the Secretary of War June 5, 1900.

7. *Bridge of the Ohio Valley Electric Railway Company across Big Sandy River from Kenova, W. Va., to Catlettsburg, Ky.*—The construction of this bridge was authorized by act of Congress of April 30, 1900. Plans and map of location were submitted May 3, 1900; approved by the Secretary of War June 12, 1900.

8. *Bridge of the Shreveport and Red River Valley Railway Company across Red River at or near Alexandria, La.*—Plans and map of location for a bridge at this place, to be built under authority of act of Congress approved April 12, 1900, were submitted June 9, 1900; approved by the Secretary of War June 15, 1900.

9. *Bridge of the Minnesota and Ontario Bridge Company across Rainy River, Minnesota.*—Construction of this bridge was authorized by act of Congress of March 9, 1900. Plans and map of location were submitted May 8, 1900; approved by the Secretary of War June 22, 1900.

10. *Bridge of Tallahatchie County, Miss., across Tallahatchie River near Swan Lake.*—Plans and map of location for a bridge at this place, proposed to be built under authority of act of Congress approved April 30, 1900, were submitted November 24, 1899; approved by the Secretary of War June 25, 1900.

11. *Bridge of the Natchitoches Railway and Construction Company across Red River at Grand Ecore, La.*—The construction of this bridge was authorized by act of Congress approved March 1, 1900. Plans and map of location were submitted April 26, 1900; approved by the Secretary of War June 25, 1900.

12. *Bridge of the St. Charles and St. Louis County Bridge Company across Missouri River at St. Charles, Mo.*—Construction of this bridge was authorized by act of Congress approved June 3, 1896, as amended by acts of May 28, 1898, and January 27, 1900. Plans and map of location were submitted April 11, 1900; approved by the Secretary of War June 27, 1900.

13. In addition to the above, plans were submitted December 13, 1899, by the *Cape Nome Transportation, Bridge and Development Company for a bridge across Snake River at Nome City, Alaska*, and were approved by the Secretary of War May 21, 1900. The construction of this bridge was authorized by act of Congress approved May 4, 1900.

Under the provisions of section 9 of the river and harbor act approved March 3, 1899, bridges may be built over navigable waters entirely within the limits of any State, under the authority of legislative enactment of such State, when the plans and locations of the structures are approved by the Secretary of War. Plans and maps of locations of the following bridges proposed to be erected under these provisions have been examined, with a view to protection of the interests of navigation, and have been approved by the Secretary of War; and the local engineer officers have been furnished with copies of the drawings and instruments of approval, and charged with the supervision of construction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. *Bridge of the city of Boston (Chelsea Bridge) across Mystic River between Boston and Chelsea, Mass.*—Plans for rebuilding the draw of this bridge and constructing a temporary bridge for use while the draw is being rebuilt were submitted August 10, 1899; approved by the Secretary of War September 7, 1899.

Plans for the extension, north, of the draw pier of this bridge were submitted June 8, 1900; approved by the Secretary of War June 29, 1900.

2. *Bridge of St. Martin Parish, La., across Bayou Teche at Bulliards Cove.*—Plans and map of location were submitted August 15, 1899; approved by the Secretary of War September 11, 1899.

3. Bridge of Mr. J. B. Levert across Bayou Teche at St. Johns Plantation, parish of St. Martin, La.—Plans and map of location were submitted August 17, 1899; approved by the Secretary of War September 11, 1899.

4. Bridge of the Highland Park Bridge Company across Allegheny River from a point at or near Highland Park, Pittsburg, Pa., to Sharpsburg, Pa.—Plans and map of location were submitted August 21, 1899; approved by the Secretary of War September 13, 1899.

5. Bridge of King County, Wash., across Snoqualmie River at Novelty.—Plans and map of location were submitted August 22, 1899; approved by the Secretary of War September 14, 1899.

6. Bridge of the city of Milwaukee, Wis., across Kinnickinnic River at Lincoln avenue.—Plans for reconstructing the existing bridge at this place were submitted August 30, 1899; approved by the Secretary of War September 21, 1899.

7. Bridge of the city of Milwaukee, Wis., across Milwaukee River at Broadway.—Plans for rebuilding the existing bridge at this place were submitted August 30, 1899; approved by the Secretary of War September 21, 1899.

8. Bridge of the Lake Shore and Michigan Southern Railway Company across Maumee River at Toledo, Ohio.—Plans for a bridge to replace the existing structure at this place were submitted September 8, 1899; approved by the Secretary of War September 27, 1899.

9. Bridge of the Louisville and Nashville Railroad Company across Tensas River near Mobile, Ala.—Plans for the reconstruction of the existing bridge at this locality were submitted August 11, 1899; approved by the Secretary of War September 28, 1899.

10. Bridge of Wahkiakum County, Wash., across Deep River.—Plans and map of location were submitted July 15, 1899; approved by the Secretary of War October 11, 1899.

11. Bridge of Sacramento County, Cal., across Georgiana Slough at Walnut Grove.—Plans and map of location were submitted August 7, 1899; approved by the Secretary of War October 17, 1899.

12. Bridge of the Kansas City, Shreveport and Gulf Railway Company across Houston River in Calcasieu Parish, La.—Plans for a bridge to replace the existing structure at this place were submitted September 30, 1899; approved by the Secretary of War October 18, 1899.

13. Bridge of the Baltimore and Ohio Railroad Company across Calumet River at South Chicago, Ill.—Plans for the reconstruction of the existing bridge at this place were approved by the Secretary of War March 1, 1894 (see Annual Report of the Chief of Engineers for 1894, p. 430). Application for permission to change the location of pier of this bridge was made by the company October 5, 1899; approved by the Secretary of War October 25, 1899.

14. Bridge of the Clearwater Short Line Railway Company across Clearwater River, near Kamiah, Idaho.—Plans and map of location were submitted September 26, 1899; approved by the Secretary of War October 25, 1899.

15. Bridge of the Ohio and Kentucky Railway Company across the North Fork of Kentucky River.—Plans and map of location were submitted October 18, 1899; approved by the Secretary of War October 27, 1899.

16. Bridge of the Carrollton Electric Railway and Bridge Company across Kentucky River at Carrollton, Ky.—Plans and map of location were submitted August 29, 1899; approved by the Secretary of War November 10, 1899.

17. *Bridge of King County, Wash., across Snoqualmie River, near Tolt.*—Plans and map of location were submitted October 23, 1899; approved by the Secretary of War November 22, 1899.

18. *Bridge of the Charleston Consolidated Railway, Gas and Electric Company (successor to the Charleston and Seashore Railroad Company) across Breach Inlet, South Carolina, between Sullivan Island and Long Island.*—Plans for construction of this bridge were approved by the Secretary of War July 6, 1898 (see Annual Report of the Chief of Engineers for 1898, p. 536), upon condition that the drawspan be increased to a width of 40 feet by March 1, 1899. This condition was not complied with, and, attention having been called to the matter, the company September 20, 1899, asked to be relieved of this requirement; approved by the Secretary of War November 29, 1899.

19. *Bridge of the city of Hoquiam, Wash., across Hoquiam River.*—Plans and map of location were submitted November 27, 1899; approved by the Secretary of War December 19, 1899.

20. *Bridge of the Bergen County Traction Company across Hackensack River at Hackensack, N. J.*—Plans and map of location were submitted December 20, 1899; approved by the Secretary of War January 4, 1900.

21. *Bridge of the townships of Springwells and Ecorse, Mich., across Rouge River at Fort street.*—Plans for a bridge at this locality, to replace an existing structure, were submitted November 10, 1899; approved by the Secretary of War January 5, 1900.

22. *Bridge of Mobile County, Ala., across Three-mile Creek, near Mobile, Ala.*—Plans and map of location were submitted October 14, 1899; approved by the Secretary of War January 18, 1900.

23. *Bridge of the city of New York (Bridge No. 3) across East River, New York.*—Plans and map of location were submitted December 2, 1899; approved by the Secretary of War January 29, 1900.

24. *Bridge of the Clearwater Valley Railroad Company across Clearwater River, near the mouth of Lapwai Creek, Idaho.*—Plans and map of location were submitted January 10, 1900; approved by the Secretary of War January 30, 1900.

25. *Temporary bridge of the city of Boston, Mass., across Mystic River.*—Plans for a bridge to replace the existing structure at this place (Malden Bridge) were approved by the Secretary of War August 12, 1899 (see Annual Report of the Chief of Engineers for 1899, p. 623). Plans for a temporary bridge for use during the reconstruction of the Malden Bridge were submitted October 20, 1899; approved by the Secretary of War November 4, 1899. Alternate plans for the temporary bridge were submitted January 13, 1900; approved by the Secretary of War January 30, 1900.

26. *Bridge of the Norfolk Railway and Light Company across Tanners Creek, near Norfolk, Va.*—Plans and map of location were submitted January 30, 1900; approved by the Secretary of War February 15, 1900.

27. *Bridges of the Guyandot Valley Railway Company across Guyandot River, West Virginia.*—Plans and maps of location for two bridges, 14½ miles and 20¼ miles, respectively, above the mouth of the Guyandot, were submitted March 3, 1900; approved by the Secretary of War March 24, 1900.

28. *Bridge of King County, Wash., across Duwamish River.*—Plans

and map of location were submitted March 7, 1900; approved by the Secretary of War March 29, 1900.

29. Bridge of the New York Bay Railroad Company across Passaic River, New Jersey.—Plans and map of location were submitted March 2, 1900; approved by the Secretary of War March 31, 1900.

30. Bridge of the Pittsburg and Lake Erie Railroad Company across the back channel of Ohio River, from Fleming Park to head of Neville Island, Pennsylvania.—Plans and map of location were submitted April 16, 1900; approved by the Secretary of War May 16, 1900.

31. Bridge of the city of Chicago across the South Branch of Chicago River at Canal street.—Plans for a bridge to replace the existing structure at this place were submitted May 9, 1900; approved by the Secretary of War May 18, 1900.

32. Bridge of the Morris and Essex Railroad Company across Hackensack River, New Jersey.—Plans for a bridge to replace the existing structure at this locality were submitted May 3, 1900; approved by the Secretary of War May 21, 1900.

33. Bridge of the city of Milwaukee, Wis., across Milwaukee River, connecting Grand avenue and Wisconsin street, Milwaukee.—Plans for reconstruction of the existing bridge at this place were submitted May 22, 1900; approved by the Secretary of War June 5, 1900.

34. Bridge of the Pittsburg and Lake Erie Railroad Company across the back channel of Ohio River at the lower end of Neville Island, Pennsylvania.—Plans and map of location were submitted May 21, 1900; approved by the Secretary of War June 12, 1900.

35. Bridge of the city of Boston, Mass., across Fort Point Channel (Broadway Bridge).—Plans for rebuilding portions of the pier of this bridge were submitted May 22, 1900; approved by the Secretary of War June 14, 1900.

36. Bridge of the city of Chicago, Ill., across Calumet River at Ninety-fifth street.—Plans for reconstructing the existing bridge at this place were submitted June 8, 1900; approved by the Secretary of War June 15, 1900.

37. Bridge of Burlington County, N. J., across Rancocas Creek at Delanco.—Plans for rebuilding the existing bridge at this place were submitted June 13, 1900; approved by the Secretary of War June 25, 1900.

38. Bridge of Benton County, Oreg., across Long Tom River at Bundys.—Plans and map of location were received January 29, 1900; approved by the Secretary of War February 2, 1900. The bridge as constructed proving unsatisfactory, new plans were submitted June 8, 1900; approved by the Secretary of War June 26, 1900.

39. Bridge of the California and Northern Railway Company across the Eureka Slough, in Humboldt County, Cal.—Plans and map of location were submitted May 29, 1900; approved by the Secretary of War June 29, 1900.

Under the provisions of section 18 of the river and harbor act approved March 3, 1899, relating to bridges obstructing navigation, plans for alteration of the following bridge, so as to render navigation through or under it reasonably free and unobstructed, have been examined and approved by the Secretary of War, and the local engineer officer has been furnished with copies of the plans and instruments of approval and charged with supervision of the work of alteration so far as necessary to see that the approved plans are complied with:

Bridge of the Chicago and West Michigan Railway Company (Pere Marquette Railroad) across Kalamazoo River at New Richmond, Mich.—Plans for alteration of this bridge in compliance with notice of the Secretary of War of April 17, 1899, were approved by the Secretary of War June 13, 1899 (see Annual Report of the Chief of Engineers for 1899, p. 624). The company having failed to make the alterations within the time specified, a new notice dated November 1, 1899, requiring the bridge to be provided with a draw having a clear width of opening over the main channel of the river of not less than 40 feet, measured at right angles to the current, was served on the company November 6, 1899. Plans for altering the bridge as required by the Department were received March 1, 1900, and accepted by the Secretary of War March 13, 1900, as satisfactory.

BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of section 18 of the river and harbor act approved March 3, 1899, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges obstructing navigation, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the alterations required to be made and prescribing a reasonable time in which to make them, as follows:

1. Bridge of the Chicago and West Michigan Railway Company across Kalamazoo River at New Richmond, Mich.—Notice dated April 17, 1899, to alter this bridge was served on the company May 8, 1899 (see Annual Report of the Chief of Engineers for 1899, p. 625), but the company having failed to alter the bridge within a reasonable time a new notice, dated November 1, 1899, was served on the company November 6, 1899. Alterations required: To construct a draw in said bridge having a clear width of opening over the main channel of the river of not less than 40 feet measured at right angles to the current. Alterations to be completed on or before one hundred and ten days from date of service of notice. February 23, 1900, the Secretary of War extended to July 15, 1900, the time for completing alterations required.

2. Bridge of the city of New Haven and town of Orange, Conn., across West River at Kimberly avenue.—Notice dated October 4, 1899, served on the mayor of New Haven and selectmen of Orange October 12 and 14, 1899, respectively. Alterations required: To provide said bridge with a draw having a clear width of opening of 45 feet at any stage of water, measured perpendicularly to the direction of the current, and having its masonry piers carried to 12 feet below the plane of mean low water. Alterations to be completed on or before one year from date of service of notice.

3. Bridge of the Sturgeon Bay Bridge Company across Sturgeon Bay, Wisconsin.—Notice dated November 15, 1899, served on the company November 24, 1899. Alterations required: To replace the present pier protection with a substantial work and protect the abutments by suitable lines of fender piling. Alterations to be completed on or before March 15, 1900.

April 20, 1900, the alterations were reported to have been completed.

4. Bridge of the townships of Ecorse and Springwells, Mich., across Rouge River at Dix avenue.—Notices dated January 12, 1900, served on the supervisors of the respective townships January 20, 1900, requiring the bridge to be either entirely removed or provided with a draw having an opening of 85 feet in the clear for the passage of boats. Alterations to be completed on or before May 15, 1900.

5. *Bridge of the Choctaw, Oklahoma and Gulf Railroad Company across Cache River, Arkansas.*—Notice dated May 11, 1900, served on the company May 17, 1900. Alterations required: To put in a longer girder giving a clear opening of 38 feet, the girder to be raised by a winch and gallows frame and to be counterweighted so that it will require not more than twenty minutes to open by the force to be kept on hand for that purpose. Alterations to be completed on or before August 1, 1900.

6. *Bridge of the Kensington and Tacony Railroad (Pennsylvania Railroad Company) across Frankford Creek, Pennsylvania.*—Notice dated June 1, 1900, served on the company June 13, 1900. Alterations required: That the said structure be changed so as to give a clear channel width of 24 feet and a high-water clearance of 10 feet through it. Alterations to be completed on or before October 31, 1900.

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

BRIDGES AT WASHINGTON, D. C.

Operations under this head were in the charge of Lieut. Col. Chas. J. Allen, Corps of Engineers.

1. *Repair of the Aqueduct Bridge across Potomac River.*—In compliance with Senate resolution, January 21, 1893, an examination of the piers of this bridge was made with the aid of a diver. A report in detail of the examination was rendered June 21, 1893, and on the 17th of July following an estimate of the cost of repairs was submitted. By act of August 18, 1894, an appropriation of $51,070 was made for the repairs. Under this appropriation Piers Nos. 2, 3, 5, 6, 7, and 8 were repaired by means of Portland cement concrete in bags, placed by a diver, and the repair of Pier No. 4 was made by means of a cofferdam within which new masonry was laid in a large eroded cavity at the upstream end of the pier. This work was completed in August, 1895.

As the work of repairs proceeded it was found that the old masonry of Pier No. 4, which was built about 1838, had not been started from solid rock and that part of it was of poor quality. There was also a crack in the masonry extending nearly throughout the entire height of the pier. It was decided that it would be necessary before long to remove the defective masonry in the remainder of the pier and replace it by masonry of proper quality founded on the solid rock. The existing appropriation was insufficient for this purpose, and it was therefore necessary to ask a further appropriation. As the cofferdam would be needed for the proposed work, it was purchased from the contractors upon completion by them of their work in 1895.

The unexpended balance of the appropriation, amounting to $4,690.30, was covered into the Treasury.

A full report and estimate of the cost of removing all the old masonry of the pier from the coping down to the bottom and rebuilding from the bottom up was rendered under date of November 30, 1895, and printed in House Doc. No. 158, Fifty-fourth Congress, first session, and in the Annual Report of the Chief of Engineers for 1896, page 3886. The cost was estimated at $65,000, which sum was appropriated for reconstruction of Pier No. 4 by act of Congress of June 8, 1896.

A contract for the work of reconstruction of that pier was made with the Houston Construction Company, of Philadelphia, Pa., May 17, and approved May 28, 1897. The total estimated amount of the contract was $30,000.

The contract work was to have been completed by November 1, 1897, but the contractors, at their request, were granted an extension of time to June 30, 1898.

The contractors abandoned the work on the 30th of April, 1898, and in consequence their contract was annulled May 27, 1898. For account of this proceeding reference is made to the Annual Report of the Chief of Engineers for the fiscal year ending June 30, 1898. War had been declared by the United States against Spain, and in view of the expected increase in travel across the bridge resulting from establishment of camps, etc., it was not deemed advisable at that time to undertake a new contract for the work.

Under date of March 27, 1899, proposals were invited through public advertisement for reconstructing the pier, and a contract for the same was made May 12, 1899, with the Central Contracting Company, of New York. The contract was to be completed on or before November 1, 1899. The time for completion was, however, upon the application of the contractors, extended to July 31, 1900.

At the close of the fiscal year ending June 30, 1900, the contractors had obtained practically all of the dimension stone required for the pier and installed pumps and derricks and constructed the falsework and tightened the cofferdam.

July 1, 1899, balance unexpended		$55,748.02
June 30, 1900, amount expended during fiscal year		2,095.65
July 1, 1900, balance unexpended		53,652.37
July 1, 1900, outstanding liabilities	$70.00	
July 1, 1900, amount covered by uncompleted contracts	37,747.00	
		37,817.00
July 1, 1900, balance available		15,835.37

(See Appendix F F F 1.)

2. *Memorial Bridge.*—The sundry civil act approved June 4, 1897, provided for a survey, examination, etc., as follows:

> Memorial Bridge across Potomac River: To enable the Chief of Engineers of the Army to make the necessary surveys, soundings, and borings, and for securing designs and estimates for a memorial bridge from the most convenient point of the Naval Observatory grounds, or adjacent thereto, across the Potomac River to the most convenient point of the Arlington estate property, two thousand five hundred dollars.

The survey was duly made, the information obtained, plotted, and mapped, and a report rendered. The report was published in House Doc. No. 388, Fifty-fifth Congress, second session.

By act approved March 3, 1899, Congress made the following appropriation:

> Memorial Rridge across Potomac River: To enable the Chief of Engineers of the Army to continue the examination of the subject and to make or secure designs, calculations, and estimates for a memorial bridge from the most convenient point of the Naval Observatory grounds or adjacent thereto, across the Potomac River to the most convenient point of the Arlington estate property, the sum of five thousand dollars.

Designs and estimates for the bridge were obtained from four of the most distinguished American bridge engineers, each of whom associated with himself at least one architect of established reputation and ability. The designs were all very complete, the estimates accurately and carefully made, and the competition in every way gratifying.

The report of the Board of Officers of the Corps of Engineers and of Architects appointed by order of the Secretary of War to consider and report upon the relative merits of these designs was submitted March 28, 1900, and it is to be regretted that time admitted of but a very few of the numerous and valuable drawings obtained being reproduced in it.

The Board recommended that design No. 2 of those submitted by Mr. W. H. Burr be adopted, with minor modifications taken mainly from his design No. 1, the cost of which modifications the detail in which his plans had been worked up rendered susceptible of easily and accurately estimating. The estimated cost of the design as recommended is $4,860,000.

This report was transmitted to Congress and published in House Doc. No. 578, Fifty-sixth Congress, first session; it is also submitted as a part of Appendix F F F 2 of this report.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	4,772.76
July 1, 1900, balance unexpended	227.24

(See Appendix F F F 2.)

MAINTENANCE AND REPAIR OF WASHINGTON AQUEDUCT, INCREASING THE WATER SUPPLY OF WASHINGTON, D. C., INVESTIGATING THE WATER SUPPLY OF WASHINGTON, D. C., AND WASHINGTON AQUEDUCT, D. C., FILTRATION PLANT.

These works were in the charge of Lieut. Col. Alexander M. Miller, Corps of Engineers, having under his immediate orders Capt. David D. Gaillard, Corps of Engineers, to September 9, 1899, and Lieut. George M. Hoffman, Corps of Engineers, since August 16, 1899.

1. *Washington Aqueduct.*—Watchmen's houses were repaired; a 24-foot by 14-foot addition to Aqueduct office was constructed and painted, and a shed and stable were constructed at the distributing reservoir. Gatehouses and storehouses were whitewashed.

The grounds at the reservoirs were cleaned. At the Dalecarlia Reservoir all low or marshy places in the shore were filled in and graded, the channels around the reservoir were freed from deposits, and the channel leading from the north connection was deepened 2 feet by dredging. A line of posts was set across the bottom lands of Little Falls Branch, just above the drainage shaft, to prevent drift piling up at the shaft during floods.

During the past year, not including the occasions when the water level was lowered for the purpose of measuring the consumption of water, the extreme fluctuation of the water level in the distributing reservoir was 4.73 feet.

The conduit between the Great Falls and Dalecarlia Reservoir was emptied three times; twice for the purpose of cleaning and once to repair leaks in Cabin John Bridge. The leaks were stopped by coating the inside of conduit with Portland cement. The conduit between the two reservoirs was also emptied and cleaned.

Preparations for repairing the by-conduit around Dalecarlia Reservoir were made.

The by-conduit around the distributing reservoir was emptied twice; once for the purpose of cleaning, and again on account of the construction of the new gatehouse at West Shaft.

Four hundred and thirty-four cubic yards of mud was removed from the canal outside of wasteweir No. 1. A new sidewalk leading to wasteweir No. 2 was constructed.

A new floor was put on the bridge across the spillway at Dalecarlia Reservoir, and a new floor for the Pennsylvania Avenue Bridge across Rock Creek was begun and about half completed. The latter bridge was painted, and also the bridge at College Pond. All bridges are now in excellent condition.

A break in the 12-inch main west of College Pond was repaired, and the 48-inch main was lowered in two localities to allow the construction of electric railway.

Measurements of the daily and hourly consumption and waste of water were made each month and gave a daily average of 48,459,977 gallons. The consumption and waste measured on June 26, 1900, were found to be 50,897,227 gallons per diem. This is the largest June measurement ever taken. The United States census of 1900 gives the population of the District of Columbia as 278,718, which gives a daily per capita consumption and waste of 183 gallons. This shows that there is a reckless waste of water in the District.

Careful and trustworthy investigations made in various cities in the United States show clearly that a daily per capita consumption of 100 gallons is ample for all domestic, business, and public purposes, and that any considerable increase above this amount must be attributed to waste.

This extravagant use of water has become a serious menace to the supply of water by the Washington Aqueduct with its present capacity—76,000,000 gallons—and at the rate of increase the ultimate limit would be reached in about twelve years.

The present consumption and waste have also an important bearing on the subject of filtration. A report on this subject was called for by Congress and was submitted March 28, 1900. (See Senate Document No. 259, Fifty-sixth Congress, first session.) It is probable that the cost of filtration will be about $6 per million gallons, or at the present rate of consumption about $300 per day, or $110,000 annually. This is a large charge and can be reduced only by a reduction in consumption.

In the opinion of the local engineer officer in charge of the aqueduct the existing conditions suggest two remedies—either the reduction of the consumption to a reasonable rate, 100 gallons per capita per diem, by the use of meters, or the increase of the present supply to keep up with the present demand by the building of a second conduit from the Great Falls of the Potomac. The necessary surveys of practicable routes for this conduit should be taken in hand at once, and an estimate for this work is submitted by the officer in charge.

Estimates are submitted for building a combined storehouse and stable at Great Falls, for preliminary surveys for an additional conduit from Great Falls, and for operation, maintenance, and repair of the Washington Aqueduct and its accessories, all of which have my approval, and of which full explanations will be found in the report of the officer in charge.

The estimates for the fiscal year ending June 30, 1902, are as follows:

For building combined storehouse and stable at Great Falls	$3,000
For preliminary surveys for additional conduit from Great Falls	8,000
For operation, maintenance, repair, etc., of the aqueduct and its accessories, including the Conduit road	25,000
Total	36,000

WASHINGTON AQUEDUCT.

Amount appropriated by act of March 3, 1899	$21,000.00
June 30, 1900, amount expended during fiscal year	18,914.73
July 1, 1900, balance unexpended	2,085.27
July 1, 1900, outstanding liabilities	2,085.27
Amount that can be profitably expended in fiscal year ending June 30, 1902	36,000.00

WASHINGTON AQUEDUCT, D. C., 1900: REPAIRING CONDUIT ROAD.

Amount appropriated by act of March 3, 1899	$1,000.00
June 30, 1900, amount expended during fiscal year	910.66
July 1, 1900, balance unexpended	89.34
July 1, 1900, outstanding liabilities	89.34

WASHINGTON AQUEDUCT, D. C., 1900: REPAIRING NORTH CONNECTION OF BY-CONDUIT.

Amount appropriated by act of March 3, 1899	$3,000.00
June 30, 1900, amount expended during fiscal year	2,240.00
July 1, 1900, balance unexpended	760.00
July 1, 1900, outstanding liabilities	760.00

(See Appendix G G G 1.)

2. *Increasing the water supply of Washington, D. C.*—This work is being prosecuted under an act approved June 30, 1898, making appropriations for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1899, and for other purposes, which authorizes and directs the Secretary of War to resume work on the Washington Aqueduct Tunnel and its accessories and the Howard University Reservoir, and to prosecute and complete the same, the work to be carried on in accordance with the plans of the board of experts as set forth in its report dated January 17, 1896.

The work recommended by the board of experts and the progress made during the fiscal year ending June 30, 1900, under the different heads may be classified as follows:

Lining unlined portions of tunnel.—During the year a total of 2,532 linear feet of lining has been completed.

Construction of invert in part of tunnel formerly lined.—A total length of 5,841 feet of this work has been done during the year.

Repairing the defective lining.—The débris, in the voids back of the old lining, consisting of timbers, cordwood, loose stone, and fallen roof, was carefully removed from the voids and replaced with solid rubble masonry for a total length of 14,091 feet. This work is now perfectly solid and as sound as new construction.

Arranging drainage of tunnel west of Rock Creek.—This involved the regrading of 2,812 linear feet of tunnel between Rock Creek and Foundry Branch, and 615 linear feet of this work was done during the year, which completes this grading.

Iron lining of tunnel at Rock Creek.—Work on the iron lining was completed during the year, 400 linear feet having been placed, backed with rubble masonry, and finished with granolithic lining.

Filling voids in dry rubble backing.—Grout was applied by drilling holes at suitable intervals through the lining, and forcing the grout in through them by hand pumps. The west and east shafts and 11,911 linear feet of old lining were thoroughly grouted.

After completing a section of the tunnel it has been given a wash coat of cement; 6,255 linear feet of the tunnel has been thus finished.

Accessory works.—The necessary drawings and plans were prepared for the gatehouses and their appurtenances, and a contract was entered into for furnishing the cut stone. Work on the excavation for the west gatehouse was begun in March, 1900, and at the close of the fiscal year the masonry was well under way and the cut stone nearly all delivered. The excavation for the east gatehouse was begun. The three air shafts were completed except the surface construction.

Contracts have been entered into for air-lift pumping plants at Champlain avenue and the east shaft, and for a centrifugal pumping plant at Rock Creek.

Howard University Reservoir.—The revetment was completed except for a portion which can not be done until the gatehouse is near completion.

Present condition of tunnel.—The present condition of the tunnel is such as to indicate that work under ground will probably be finished by January 1, 1901.

Estimates.—The board of experts in their estimate for the completion and repair of the tunnel gave the amount required for completion of the tunnel proper and its accessories as $897,837. This estimate did not include the amount necessary to complete the Howard University Reservoir—to place it in a condition to be available in connection with the tunnel for the new system of water supply.

It is estimated by the engineer officer in charge that $170,673.14 will be required to complete the reservoir, and also that it will require a further expenditure of $439,567.96 to complete the tunnel and accessories. This would make $610,241.10 as necessary on July 1, 1900, to complete the tunnel and reservoir. There was available at this date $448,018.13, leaving a balance necessary to complete the work, including the Howard University Reservoir, of $162,222.97. This estimate is approved by me.

July 1, 1899, balance unexpended		$658,160.03
Amount appropriated by act approved June 6, 1900		139,034.34
		797,194.37
June 30, 1900, amount expended during fiscal year		316,788.67
July 1, 1900, balance unexpended		480,405.70
July 1, 1900, outstanding liabilities	$32,387.57	
July 1, 1900, amount covered by uncompleted contracts	180,091.31	
		212,478.88
July 1, 1900, balance available		267,926.82
Amount (estimated) required for completion of existing project		162,222.97
Amount that can be profitably expended in fiscal year ending June 30, 1902, in addition to the balance available July 1, 1900		162,222.97

(See Appendix G G G 2.)

3. Investigating water supply of Washington, D. C.—This work was conducted under the provisions of acts approved June 30, 1898, and March 3, 1899, calling for a detailed estimate of the cost of filtering the water supply of Washington, D. C.

As a result of investigations in practical filtration carried on during the year, it was found that the Potomac water as supplied to the city of Washington could not be satisfactorily filtered by the English or slow sand filtration, but that good results could be obtained by the rapid or American method.

A report was submitted on March 28, 1900 (Senate Doc. No. 259, Fifty-sixth Congress, first session), and it was recommended that the American system be adopted.

July 1, 1899, balance unexpended	$6,083.37
June 30, 1900, amount expended during fiscal year	6,083.37

(See Appendix G G G 3.)

4. Washington Aqueduct, District of Columbia, filtration plant.—By act approved June 6, 1900, an appropriation of $200,000 was made—

> For establishing those portions of a filtration plant which are essential to the operation of either system of filtration adopted, including necessary land, grading, masonry, and appurtenances.

The necessary studies resulted in the submission, by the engineer officer in charge, of a project for the purchase of land for a filter plant and clear-water basin, which would be essential to the operation of either system of filtration adopted.

In the report on the Feasibility and Propriety of Filtering the Water Supply of Washington, D. C., estimates were submitted for two systems of filtration. The estimate for the slow or English system was $2,461,338; for the rapid or American system, $1,081,377. It would appear from the wording of the above appropriation that Congress, although expressing approval of some system of filtration as necessary, has not definitely decided which system should be adopted.

With the appropriation of $200,000 made by act approved June 6, 1900, probably sufficient land may be purchased for the American system, but for the English system the land alone is estimated to cost $555,588.

In either case the plant would require two years at least to erect. Therefore, in the case of the English system, $555,588 plus one-half of the remainder of the estimate—$952,875, or in all $1,508,463—or, say, $1,500,000, could be advantageously expended during the fiscal year ending June 30, 1902.

In case the American system be adopted $700,000 can be advantageously expended, or $500,000 in addition to the $200,000 already available. The above amounts are asked for in the estimates.

Amount appropriated by act of June 6, 1900	$200,000.00
July 1, 1900, balance unexpended and available	200,000.00

Amount (estimated) required for completion of English system	2,261,338.00
Amount (estimated) required for completion of American system	881,377.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, if English system be adopted, in addition to the balance available July 1, 1900	1,308,463.00
Amount that can be profitably expended in fiscal year ending June 30, 1902, if American system be adopted, in addition to the balance available July 1, 1900	500,000.00

(See Appendix G G G 4.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT, IN THE DISTRICT OF COLUMBIA.

Officer in charge, Col. Theo. A. Bingham, United States Army.

The Executive Mansion has received the usual care and such repairs and improvements as the funds available would admit. The electric light and power cables have been placed underground in the concrete tunnel constructed last year and a new lead-covered cable placed in position for the automatic telephone service. The blue parlor has been redecorated and refurnished and some of the other apartments repapered and repainted. Some new carpets, window draperies, lace curtains, and other furnishings were purchased. The conservatory was repainted, repairs made to that building and to the greenhouses, and repairs and improvements made about the stable.

The Washington Monument and its steam and electric light machinery have received necessary attention, repairs having been made from time to time as required. New tap wires have been run from the main wire to the electric lamps, from the bottom floor to the 380-foot landing, and new telephones have been placed in the elevator car, engine room, boiler house, and lodge house.

Inspections have been made from time to time of the various buildings occupied by the War Department, except the State, War, and Navy Departments building, in connection with their care, repair, and safety.

At the propagating gardens and nursery repairs were made to greenhouses and other buildings and considerable progress made in filling the low ground temporarily added to the area of the nursery in May, 1899, from that portion of Potomac Park adjoining the nursery on the west, which ground has also been inclosed with a cedar post and wire fence. About 780,000 plants were propagated for park decoration.

The care required to maintain them in good condition has been extended to the improved parks and park places. Twenty-one of the unimproved parklets, containing 8.5 acres, have been brought to their first stage of improvement, one of them having been prepared as a playground, six inclosed with iron post-and-chain fences, a fountain constructed in one, and marking stones placed at the corners of five. Bridle paths for equestrians only have been constructed in the President's Park and in the Monument grounds, and a new roadway entrance from Fourteenth street constructed in the southeastern part of the latter grounds. The asphalt pavements in the parks have been extended by the construction of 981 square yards of roadway and 2,135 square yards of footwalk, and 312 square yards of asphalt roadway and 574 square yards of asphalt footwalk has been repaired and resurfaced. Ninety-eight feet of cobblestone gutters has been constructed, and 322 feet of drainpipe and 1,032 feet of water pipe laid. A fence of cedar posts and wire has been constructed along the south and west boundary lines of the compost and storage grounds.

The terrace, buttresses, and steps of the pedestal for the statue of General Sherman have been completed, the foundation for the monument to Samuel Hahnemann constructed by the United States, and the monument erected by the Monument Committee of the Society of American Homeopathists, and the foundation for the pedestal for statue of Gen. Albert Pike constructed by the sculptor.

A fence has been erected in front of the O-street portion of the United States wharf property lying between the Arsenal grounds and N street south.

Attention has been given to the telegraph line connecting the Capitol with the departments and Government Printing Office, repairs having been made from time to time as needed. The desirability of replacing the present overhead system with underground conduits and cables is submitted for the action of Congress.

The damage done by the storm in February, 1897, and by high tide and wind in October, 1898, to the iron-pile wharf at Bridge Creek Landing, Virginia, near Wakefield, the birthplace of Washington, has not yet been repaired, there being no funds available for the work.

Attention is invited to the detailed report of the officer in charge and to his estimates and recommendations for the fiscal year ending June 30, 1902.

The estimates are as follows:

For the improvement and care of public buildings and grounds in charge of the Chief of Engineers		$195,506
For compensation of persons employed on public buildings and grounds		66,620
For repair of existing telegraph lines connecting Capitol and departments		1,500
For contingent and incidental expenses of public buildings and grounds		600
For United States wharf from north line of Arsenal grounds to southern curb line of N street south; for cleaning up, clearing away, removing old buildings, piles, etc		5,000
For care of Washington Monument and maintenance of elevator:		
Salaries of employees	$8,520	
Fuel, lights, contingencies, etc	3,000	
		11,520
Total		280,746

(See Appendix H H H).

NORTHERN AND NORTHWESTERN LAKES—CORRECTING AND ISSUING CHARTS—SURVEYS—WATER LEVELS.

As far back as 1817 local surveys on the Great Lakes for special purposes were made by engineer officers, but the survey of the lakes as a systematic work was commenced in 1841 and completed in 1882. The survey proper has from the beginning been conducted under the War Department, at first under the Chief of Topographical Engineers, and after the consolidation of that Corps with the Corps of Engineers under the Chief of Engineers.

The first regular appropriation for the survey was made in 1841, and from that year until 1882, with the single exception of 1847, annual appropriations were made.

The following extract from "Professional Papers of the Corps of Engineers, United States Army, No. 24," describes the conditions governing the navigation of the Great Lakes in 1841:

> 1. The lake survey was begun in 1841, under an appropriation of $15,000, made in May of that year. At this time the country bordering on the lower lakes was already pretty well settled, and works for the improvement or formation of harbors had been commenced at most of the important points on Lakes Erie and Ontario. The upper lake region was but thinly settled, and there were no good harbors on Lake Huron, and but one (the Harbor of Chicago) on Lake Michigan. Settlers were, however, pouring in rapidly, and there was even then a large and constantly increasing commerce between the lake ports, especially from Buffalo to Detroit and Chicago. Com-

munication with Lake Superior could only be had by portage around the Sault Ste. Marie, but the great mineral wealth of the Lake Superior country was attracting attention, and a survey for a ship canal had been made in 1840 by officers of the Topographical Engineers. The lake commerce was carried on under many difficulties, which caused much loss of life and property each year.

There were no charts of the lakes except the admiralty charts compiled from the surveys of Capt. H. W. Bayfield, of the royal navy (English), and these were not in general use by the masters of American vessels. These charts were the results of rapid reconnaissances, and although they showed the coast lines with an accuracy which is remarkable considering the rough methods of surveying employed, they were of little value as hydrographical charts of the American coast, because they showed the depths of water in comparatively few places and but a small number of the many reefs and shoals which are found along the lake shores.

There were few light-houses and beacons to indicate the positions of dangers to navigation, and in the absence of charts, pilots were obliged to rely upon their own knowledge, which was frequently only acquired by the vessel's grounding on a shoal or striking a hidden rock.

The navigation of the lakes is attended with peculiar dangers, because, while violent gales are frequent and the storms rival those of the ocean itself, a vessel is never more than a few hours' run from the shore, and can not, as is generally the case at sea, drift before the wind until the storm is over, but in a long-continued gale must be thrown upon the shore, unless a port or harbor of refuge can be entered. In 1841 a vessel leaving Chicago found no harbor or shelter in storms until the Manitou or Beaver Islands were reached, and after passing the Straits of Mackinac it was again exposed without refuge on Lake Huron, except in the vicinity of Presque Isle, until the head of the St. Clair River was reached. In sailing from Chicago to Buffalo the greatest difficulties were encountered in the vicinity of the Straits of Mackinac and in the west end of Lake Erie, on account of the many islands, shoals, and reefs found in those localities, and at the mouth of the St. Clair River, at which no improvements had been made in 1841, and where the channels were not only circuitous and narrow but so shoal that vessels in low-water seasons frequently were compelled to have their cargoes taken over the bars in lighters.

It was therefore with the double object of furnishing reliable charts to lake vessels and of determining from the surveys the works of improvement which were necessary to the prosperity of the lake commerce that Congress in 1841 directed a survey of the lakes, and that annual appropriations, with the single exception of the year 1847, have since been made for carrying on the survey. Some idea of the magnitude of the work may be had from the following dimensions:

"The American shore line of the Great Lakes and their connecting rivers, if measured in steps of 25 miles, is about 3,000 miles, but if the indentations of the shore and the outlines of the islands be included the developed shore line is about 4,700 miles in length.

"Along rivers and where a lake is narrow it is necessary for navigation that both shores be mapped. This increases the length of the shore line to be surveyed between St. Regis, N. Y., and Duluth, Minn., to about 6,000 miles."[1]

During the first ten years of the survey, whilst a general geodetic survey of the entire chain of lakes was contemplated for the future, the actual operations were mainly confined to surveys of special localities where improvements were called for or where the navigation was difficult, and where the surveys were more extended they were little more than reconnaissances. This course was made necessary because the appropriations were inadequate to the purchase of the finer instruments and the support of the larger force necessary for more extensive and more exact surveys, and also because of the pressing need of improvements at particular localities, for which preliminary surveys were essential.

For the support of the survey, completed in 1882, Congress appropriated a total of $2,939,879, of which a surplus of $2,382.52 was returned to the Treasury. The execution of the survey involved a great quantity of astronomical, topographical, and hydrographic work, all of which was performed with a high degree of skill and accuracy. The result was the completion of a series of reliable charts for lake vessels and the furnishing of a basis for works of channel improvement upon the lakes themselves and their connecting waters.

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[1] From memoranda respecting the lake survey by Gen. C. B. Comstock, published in the Report of the Chief of Engineers for 1875.

The original series consisted of 76 charts, all of which were printed from copperplates.

From 1882 till 1889 operations were limited to the publication and issue of charts, but since the latter year new surveys have been made as a basis for additions and corrections to the original charts, under appropriations aggregating $280,000. In 1898 operations were extended to include the cognate work of observing and investigating the levels of the Great Lakes with a view to their regulation. As a result of additions and cancellations, there are now in force 73 of the lake survey charts, 67 of which are printed from copperplates and 6 are photolithographed in colors.

From 1882 to June 30, 1900, the work of printing, electrotyping, and issuing the charts was provided for by eighteen appropriations, aggregating $42,000. During the same period a total of $14,394.45 was derived from the sale of charts and turned into the United States Treasury, making the net cost of this service $27,605.55 for the past eighteen years. Up to February 20, 1890, one full set of charts was issued free to each United States registered vessel; any additional charts furnished such vessels, and all furnished for other unofficial use, were sold at the uniform price of 30 cents each. On the date above mentioned the free issue, except for official purposes of the Government, was discontinued pursuant to law, and since then the charts have been sold for all private and unofficial use at prices ranging from 6½ cents to 31 cents each, the price being intended in each instance to cover only the cost of paper and printing.

The central office for the sale or issue of charts is the United States Engineer Office at Detroit, Mich., and the total number disposed of there during the last fiscal year was 7,166; of this number 6,536 were sold and the proceeds from sales, amounting to $1,387.53, were duly deposited to the credit of the Treasurer of the United States. About 231,000 of these charts have been sold and issued to date.

During the year important corrections and additions were made in the Detroit Office to eighteen of the old charts, and corresponding corrections were applied to the electrotype plates, from which new editions of the said eighteen charts and seven others were printed in the Office of the Chief of Engineers at Washington, D. C. A new chart of part of the St. Marys River, and one of a part of the vicinity of the Apostle Islands, in Lake Superior, were also prepared in the Detroit Office, and both were subsequently photolithographed in colors. Numerous local surveys and examinations were made to provide data for projecting these new charts and correcting the old ones. A considerable revision of the charts now under way has for its object to show to date certain changes which have taken place, due to natural and artificial agencies, to better serve the deeper draft vessels now engaged in lake commerce, and to indicate the somewhat reduced depths of water which now prevail during the season of navigation. Many of the original charts were prepared with reference to a navigation calling for a draft not exceeding 12 feet; the soundings were referred to planes representing mean or average stages of water, and general depths exceeding 18 feet below such planes were not closely exploited. Present conditions of commerce demand, however, that the bottom be accurately charted to depths of not less than 30 feet in the open lakes, or 25 feet in their connecting rivers or straits, and these depths should relate to ordinary "low-water" stages, instead of to the "mean stages" referred to above. This will call for extensive surveys and a vast quantity of office work, all of which must be done with great care and accuracy. To secure a satisfactory rate of progress will require an expenditure of at least $150,000 during the year ending June 30, 1902.

In addition to work relating to charts, the Detroit Office was engaged during the year under the project adopted in 1898 for an exhaustive investigation of lake levels, as described in the Annual Report of the Chief of Engineers for that year, pages 3774–3776. The principal field work comprised an accurate series of discharge measurements in the Niagara, St. Clair, and St. Marys rivers, together with local surveys related to these measurements; also the maintenance of fifteen self-registering water gauges on the several lakes, from Ontario to Superior and Michigan, which supply an accurate and continuous record of the most minute changes in the elevation of the water surface. This work is now fully organized, and it is highly important that it be pushed to completion as rapidly as possible. For this purpose the sum of $50,000 should be made available for expenditure during the year ending June 30, 1902.

It is therefore recommended that the appropriation for that year be made to include the two amounts indicated above, and that it be formulated as follows:

Estimate for the fiscal year ending June 30, 1902.

For survey of northern and northwestern lakes, including all necessary expenses of correcting, extending, printing, and issuing charts, and of investigating lake levels with a view to their regulation, to be available until expended	$200,000.00

SURVEYS, ADDITIONS TO, AND CORRECTING ENGRAVED PLATES.

July 1, 1899, balance unexpended	41,483.20
June 30, 1900, amount expended during fiscal year	33,246.35
June 30, 1900, balance unexpended	8,236.85
Amount appropriated by sundry civil act approved June 6, 1900	75,000.00
July 1, 1900, balance unexpended	83,236.85

PRINTING AND ISSUING CHARTS.

July 1, 1899, balance unexpended		3,565.06
June 30, 1900, amount expended during fiscal year	$2,596.71	
Reverted to Treasury	486.06	
		3,082.77
June 30, 1900, balance unexpended		482.29
Amount appropriated by sundry civil act approved June 6, 1900		3,000.00
July 1, 1900, balance unexpended		3,482.29

Dates and amounts of appropriations for survey of Northern and Northwestern Lakes.

March 3, 1841	$15,000
May 18, 1842	20,000
March 1, 1843	30,000
June 17, 1844	20,000
March 3, 1845	20,000
August 8, 1846	25,000
August 12, 1848	25,000
March 3, 1849	10,000
September 28, 1850	25,000
March 3, 1851	25,000
August 30, 1852	25,000
March 3, 1853	50,000
August 5, 1854	50,000
March 3, 1855	50,000
August 30, 1856	50,000
March 3, 1857	50,000
June 12, 1858	75,000
March 3, 1859	75,000
June 21, 1860	75,000
March 2, 1861	75,000
July 5, 1862	105,000
February 9, 1863	106,879
July 2, 1864	100,000
February 28, 1865	125,000
June 12, 1866	50,000
March 2, 1867	77,500
March 2, 1868	$77,500
July 20, 1868	75,000
March 3, 1869	100,000
July 15, 1870	100,000
March 3, 1871	175,000
June 10, 1872	175,000
March 3, 1873	175,000
June 23, 1874	175,000
March 3, 1875	150,000
July 31, 1876 (not including $16,000 applied to survey of Mississippi River)	84,000
March 3, 1877 (not including $25,000 applied to survey of Mississippi River and including $9,500 received from sale of steamers)	94,500
June 20, 1878 (not including $49,500 applied to survey of Mississippi River)	49,500
March 3, 1879	85,000
June 16, 1880	40,000
March 3, 1881	18,000
August 7, 1882	12,000
Total	2,939,879

PRINTING AND ISSUE OF CHARTS FOR USE OF NAVIGATORS, AND ELECTROTYPING COPPERPLATES FOR CHART PRINTING.

March 3, 1883	$3,000
July 7, 1884	3,000
March 3, 1885	3,000
August 4, 1886	2,000
March 3, 1887	2,000
October 2, 1888	2,000
March 2, 1889	2,000
August 30, 1890	2,000
March 3, 1891	2,000
August 5, 1892	2,000
March 3, 1893	$2,000
August 18, 1894	2,000
March 2, 1895	2,000
June 11, 1896	2,000
June 4, 1897	2,000
July 1, 1898	3,000
March 3, 1899	3,000
June 6, 1900	3,000
Total	42,000

SURVEYS AND ADDITIONS TO AND CORRECTING ENGRAVED PLATES.

March 2, 1889	$5,000
August 30, 1890	10,000
March 3, 1891	10,000
August 5, 1892	5,000
March 3, 1893	25,000
August 18, 1894	25,000
March 2, 1895	25,000
June 11, 1896	$25,000
June 4, 1897	25,000
July 1, 1898	25,000
March 3, 1899	25,000
June 6, 1900	75,000
Total	280,000

(See Appendix I I I 1.)

Preservation of bench marks along the Erie Canal.—The retransfer of 16 bench marks, which were threatened with obliteration by the enlargement of the Erie Canal by the State of New York, was completed in July, 1899. The work was in the charge of Capt. Graham D. Fitch, Corps of Engineers, whose report will be found in Appendix I I I 2.

Annual water levels of the Northern and Northwestern Lakes.—A table showing the monthly means of water levels from July 1, 1899, to June 30, 1900, at Charlotte and Oswego, Lake Ontario; at Erie, Ashtabula, and Cleveland, Lake Erie; at Milwaukee, Lake Michigan; at Escanaba, on Green Bay (no observations being made at the latter place from

January 16 to March 31, 1900, inclusive); at Sand Beach, Lake Huron; at Sault Ste. Marie and Marquette, Lake Superior, being a continuation of that published in the Annual Report of the Chief of Engineers for 1899, will be found in Appendix I I I 3.

Charts.—Under the supervision of this office during the fiscal year additions have been made to the engraved plates of—

Lake Superior, No. 3.
River Ste. Marie, No. 2.
Straits of Mackinac.
North End of Lake Michigan.
South End of Lake Michigan.
Beaver Island Group, Lake Michigan.
South End of Green Bay.
Coast Chart No. 3, Lake Michigan.
Coast Chart No. 4, Lake Michigan.
Coast Chart No. 5, Lake Michigan.
Coast Chart No. 6, Lake Michigan.
Coast Chart No. 8, Lake Michigan.
Grand and Little Traverse bays, Lake Michigan.
Lake Huron.
Saginaw Bay, Lake Huron.
Tawas Harbor, Lake Huron.
Lake St. Clair.
Detroit River.
Lake Erie.
Coast Chart No. 3, Lake Erie.
Coast Chart No. 6, Lake Erie.
Coast Chart No. 7, Lake Erie.
Sandusky Bay.
Lake Ontario.
Coast Chart No. 1, Lake Ontario.

An edition of each of the following charts has been photolithographed and printed.

St. Marys River, No. 1.
Apostle Islands, No. 1.

IMPROVEMENT OF THE YELLOWSTONE NATIONAL PARK, INCLUDING THE CONSTRUCTION, REPAIR, AND MAINTENANCE OF ROADS AND BRIDGES.

Officer in charge, Capt. Hiram M. Chittenden, Corps of Engineers.

The work has been in the charge of the Engineer Department since 1883, except during the period from August, 1894, to March, 1899.

The project embraces the construction of a belt-line road, including all the important centers of interest in the park, viz: Mammoth Hot Springs, Norris Geyser Basin, the Firehole Geyser Basins, the Yellowstone Lake, the Canyon and Falls of the Yellowstone, and the section near Tower Falls; also four approaches leading from the boundary of the Park to different points on the belt line; the numerous side roads to isolated objects of interest, as well as bridle trails for use by exploring parties and by troops and scouts in patrolling the Park. The estimated total mileage of the completed system is about 300 miles in the Park proper and 330 miles including the roads in the Forest Reserve.

The estimated total cost of the project, excluding annual maintenance and repairs, is $850,000. Of this sum $425,000, in round numbers, has already been expended; about $45,000 is available for expenditure during the fiscal year 1901, and $380,000 is required. The cost of annual maintenance and repairs has been $161,320.78. The result of the expenditure thus far, after certain portions of the road are rebuilt, will be about 176 miles of road and 80 bridges constructed. There remains to be built about 154 miles of road, 11 costly bridges, and a large number of smaller bridges.

The work during the fiscal year ending June 30, 1900, was all done from the appropriation act of March 3, 1899. Of the $40,000 appropriated, $4,500 was allotted for the purposes of protection to be disbursed by the acting superintendent, and some protection work was done by the Engineer Department in the repair of station houses and for the troops patrolling the Park. The total amount applied to protection was $5,534.64, leaving $34,465.36 available for improvement and maintenance. The sum of $5,000 having been used in repairs prior to July 1, 1899, there remained only $29,465.36 for the year ending June 30, 1900. Of this sum $22,016.04 was expended in new work; $7,194.57 in repairs, and $254.75 in surveys.

The new work was virtually maintenance and repairs, for it nearly all consisted in the reconstruction of old roads which had long been considered dangerous. The principal part of the work was on a new location of 3 miles of road between Mammoth Hot Springs and Golden Gate, and on a short stretch in the valley of the Gardiner below Mammoth Hot Springs. Both pieces of work were exceptionally difficult and consequently costly. In the valley of the Gibbon River a wagon trail has been opened down the right bank from the belt line to near the mouth of the Firehole to connect with the western approach. This work involved the construction of a cheap bridge.

The repair work extended over the entire system. The damages to the road in the spring of 1899 were unusually extensive, owing to the extraordinary lateness of the season, depth of snow, and resulting high water. The present season is exactly the reverse of that of last year, being very early, with little snow and no serious freshets. The damages to the roads have therefore been small and the work of repair light.

The estimate for the current fiscal year is renewed, with a slight modification in a few items, due to more exhaustive surveys. The project has been extended by the action of Congress, act of June 6, 1900, authorizing the construction of a road from the outlet of the Yellowstone Lake to the east boundary of the Forest Reserve and making an appropriation for its commencement. The distance is about 50 miles and involves the construction of two large bridges and several smaller ones. The cost will not be less than $100,000 for the road work and $15,000 for the bridges.

The economy and utility of the work in the Yellowstone National Park would be greatly increased by providing for its completion by continuous appropriations within a period of three years. If this can not be done, extra provision over the usual annual allowance should be made for the required bridges. These works are urgently needed and are too costly to be built from appropriations of the size heretofore made. Several of the old bridges are now unsafe and ought not to be used longer.

The sundry civil act of June 6, 1900, provides as follows:

> Improvement of the Yellowstone National Park: For the repair and maintenance of existing roads and bridges and improvement and protection of the Yellowstone National Park, to be expended by and under the direction of the Secretary of War, sixty thousand dollars, of which amount five thousand dollars shall be immediately available for the repair of roads: *Provided*, That of this amount twenty thousand dollars, or so much thereof as may be necessary, shall be used in the construction of a wagon road and the necessary bridges through the Yellowstone Park Timber Reserve along the North Fork of the Stinking-water or Shoshone River and through the Yellowstone Park by way of the Jones Creek trail or other most practicable route to a point on the Yellowstone River near where said river flows from Yellowstone Lake: *Provided further*, That road extensions and improvements shall hereafter be made in said park under and in harmony with a general plan of roads and improvements to be approved by the Chief of Engineers of the Army.

Inviting special attention to the detailed report of Capt. H. M. Chittenden, Corps of Engineers, for the fiscal year ending June 30, 1900, and to his report of August 20, 1900, herewith, submitting a general plan for road extensions and improvements in the Park, I have the honor to state that the general plan of roads and improvements as submitted is approved by the Chief of Engineers, and that hereafter all road extensions and improvements in the Park under the Engineer Department will be in harmony with these approved projects.

It is earnestly recommended that the same system shall be applied to appropriations for improvements in the Yellowstone Park that holds in river and harbor works, and that hereafter such appropriations be made available upon the passage of the act and continue available until expended.

It is also recommended that the item for police duty in the Park be separate and distinct from that for improvement work.

The item for improvement is expended under the direction of the Secretary of War; the item for police duty is expended under an officer who reports to the Secretary of the Interior.

July 1, 1899, balance unexpended	$35,383.78
Amount appropriated by sundry civil act approved June 6, 1900 ($5,000 immediately available), less $5,000 allotted for protection	55,000.00
Amount transferred by Interior Department	248.61
	90,632.39
June 30, 1900, amount expended during fiscal year	33,902.17
July 1, 1900, balance unexpended	56,730.22
July 1, 1900, outstanding liabilities	5,458.71
July 1, 1900, balance available	51,271.51
Amount estimated for completion of existing project after work of current season, in which about $45,000 of appropriation will be expended in new work and $15,000 in repairs ($425,000 estimated cost of completion, less $45,000)	380,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1902:	
For new work, in addition to the balance available July 1, 1900	380,000.00
For maintenance of improvement	15,000.00

(See Appendix J J J.)

RECONNAISSANCES, EXPLORATIONS, AND WORK IN THE FIELD.

Engineer officers and acting engineer officers on the staffs of commanding generals of military divisions and departments have been engaged during the year in building and repairing railroads, wagon roads, and bridges, making surveys in the field, making and distributing maps, and in other duties incidental to the work of engineers in the field.

Reports of such work have been submitted by the following officers:

Capt. John Biddle, Corps of Engineers, at Division of the Philippines.

Capt. William V. Judson, Corps of Engineers, at Department of Porto Rico.

Capt. Henry P. McCain, Fourteenth United States Infantry, at Department of the Columbia.

Capt. John B. Bennet, Sixteenth United States Infantry, at Department of the Colorado.

Capt. John Biddle, Corps of Engineers, Chief Engineer of the Division of the Philippines, reports in detail concerning engineering operations in that division; gives names of officers in charge of the engineer department at headquarters, of engineer officers and acting engineer officers in the various departments, and of those serving in the office of the chief engineer. The funds for civilian assistants to engineer officers were expended for hire of employees in the office and field; funds for equipment of engineer troops were expended for purchase and repair of tools and materials for bridge and road work, instruments for reconnaissances and surveying, supplies for drafting and duplicating maps, photography, etc. The climate is very hard on all materials, particularly those employed in photography and map printing. Drawing and surveying instruments rust rapidly. The office work has been the regular routine, the issue of materials, tools, and instruments, the drawing and distribution of a large number of maps; all Spanish maps available have been combined, traced, and printed, and considering the undeveloped nature of the country, have been fairly accurate; the road maps covering certain military expeditions have proved accurate and full of detail, except that the roads and bridges, having been neglected for some years, are in worse condition than the maps would indicate. It has been possible to furnish to all expeditions maps of considerable value. Considerable work has been done toward securing a military map of the whole archipelago, but it is still in the initiatory stage. The photographic work, of which a large part was done by the men of engineer companies, consisted in views of engineer work done in the field and on the railroad, views of forts, of landscapes, etc. The detachments of engineer troops accompanying expeditions and other detachments have been supplied from the depot with instruments and with tools and materials for building roads, bridges, and ferries. Much work of relaying track and rebuilding roadbed and bridges was done on the Manila and Dagupan Railroad during the advance and since the occupation of the district by our forces. This work was mostly done by Officers of the Corps of Engineers and engineer troops under the supervision of the engineer officer of the department. Several hundred miles of wagon road have been worked over, more or less, and a dozen or so highway bridges built and many repaired. The work of the engineer companies has been almost entirely in connection with road repair and bridge building and has been excellent. The small number of officers and men of engineers available has proved a great disadvantage, especially during the movements in central Luzon. Practically all the plant sent out, including tools, instruments, and materials, has been of use. Excepting the chess, the advance guard ponton train has not been used. The white ants make it difficult to keep this train in good order. A certain amount of work has been done in connection with the public works in Manila Harbor. Examinations of the existing forts at Jolo and Manila have been made by engineer officers.

(See Appendix K K K 1.)

Capt. William V. Judson, Corps of Engineers, Engineer Officer, Department of Porto Rico, reports that he relieved First Lieut. Samuel G. Jones, Fifth United States Cavalry, Acting Engineer Officer of the Department, August 27, 1899; that during the incumbency of Lieutenant Jones the office duties involved the preparation of various reports upon land matters; the issue to officers of instruments, drawing materials, etc.: prosecution of dredging operations; wharf policing and repairs, and equipment of machine shop, all at San Juan. Up to May 1, 1900, Captain Judson was president of the Board of Public Works of Porto Rico, the work of the Board involving insular expenditures. As engineer officer of the department has had immediate charge of the disbursement of the $950,000 of moneys appropriated by Congress and devoted to the construction of roads, etc., in Porto Rico, to relieve the people who were suffering from starvation and and sickness incident to the hurricane of August 8, 1899. Several military reservations have been surveyed, or titles thereto investigated; maps have been prepared showing the lands of public ownership on San Juan Island; this work has been only tentatively completed, as titles and descriptions are in most cases very defective; a topographical map of Porto Rico has been begun, but has not been pushed, partly for lack of time and partly because the road surveys and coast survey data will soon be available, and should be embodied in any new map. Harbor lines at San Juan Harbor have been recommended for adoption to the Secretary of War. The construction of a pier at this harbor, under revocable license issued to the New York and Porto Rico Steamship Company, has been supervised, and data procured for report of cost to the Secretary of War. Many reports have been submitted upon matters relating to franchises and concessions in Porto Rico, and reports on various engineering subjects have been prepared for the department commander; engineer property has been cared for, and, upon request, officers serving in the Department have been furnished instruments and materials.

(See Appendix K K K 2.)

Capt. Henry P. McCain, Fourteenth United States Infantry, Acting Engineer Officer, Department of the Columbia, reports that the field work consisted of instrumental surveys for extensions to the water and sewerage systems at Vancouver Barracks, Wash.; laying out of camps and buildings for accommodation of volunteer organizations ordered to rendezvous at Vancouver Barracks, and supervision of construction of same; that office work consisted of preparation of plans, profiles, and specifications for extensions to water and sewerage systems at Vancouver Barracks; detail plans of volunteer camps at Vancouver Barracks, and plan of post of Vancouver Barracks showing camps of volunteers; making tracing of map of trail from Port Valdez to Fort Egbert; of map of proposed military reservation at Fort Egbert; of map of Fort Kodiak; of map of proposed military reservation at Skagway; making plan of Vancouver Barracks, with new system of numbering; plan and specification of 75-foot flagstaff, and plan of Fort Spokane, Wash., with water and sewerage systems, for Interior Department; collecting and compiling data for department maps; photographic work of Alaska Exploring Expedition of 1899, under command of Capt. E. F. Glenn. Forty-five solar prints and 222 silver prints were made and 16 maps were mounted on muslin.

(See Appendix K K K 3.)

Capt. John B. Bennet, Sixteenth United States Infantry, Acting Engineer Officer, Department of the Colorado, reports that office work during the past year was confined to making a number of tracings and blue prints of official maps on file, and to caring for engineer property in the office and issued to post engineer officers. No field work was done other than sketches of practice marches and field exercises.

(See Appendix K K K 4.)

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military departments, being an average of $1,428.57 for each of seven military departments west of the Mississippi River, $10,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed Officers of the Corps of Engineers, or other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys, and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and consequently these officers have been very much cramped for lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revision and additions, which the officers make so far as possible; but with no means, even for the purchase of paper, their efforts are limited in results.

For publication of maps for use of the War Department, inclusive of war maps, $5,000.

Paragraph 351 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation are now being honored as rapidly as possible. To further the work $5,000 should be appropriated for the fiscal year ending June 30, 1902.

CONSTRUCTION OF MILITARY ROAD FROM FORT WASHAKIE TO MOUTH OF BUFFALO FORK OF SNAKE RIVER, WYOMING.

Officers in charge, Capt. James C. Sanford, Corps of Engineers, to October 17, 1899, and Capt. Hiram M. Chittenden, Corps of Engineers, after that date.

The first appropriation for this work was made by act of June 4, 1897; construction was commenced in August, 1898, and finished in October of the same year so far as funds would permit. For description of the locality, character, and value of the road, and work done to June 30, 1899, see Annual Report of the Chief of Engineers, 1899, Part VI, pages 3881–3900.

No work was done during the year except care of property.

Amount expended to June 30, 1899, $9,832.32.

Amount expended during fiscal year ending June 30, 1900, $142.56.

The sundry civil act of June 6, 1900, appropriated $10,000 for repair and completion of the road. A project was submitted June 17, 1900, approved June 22, 1900, and preparations were made for commencing the work.

July 1, 1899, balance unexpended	$167.68
Amount appropriated by act of June 6, 1900	10,000.00
	10,167.68
June 30, 1900, amount expended during fiscal year	142.56
July 1, 1900, balance unexpended	10,025.12
July 1, 1900, outstanding liabilities	6.73
July 1, 1900, balance available	10,018.39

(See Appendix L L L.)

ERECTION OF MONUMENT TO SERGEANT CHARLES FLOYD.

Officers in charge, Capt. James C. Sanford, Corps of Engineers, to October 17, 1899, and Capt. Hiram M. Chittenden, Corps of Engineers, after that date.

The deficiency act of March 3, 1899, appropriated $5,000 for the erection, in cooperation with the Floyd Memorial Association, of a monument near Sioux City, Iowa, over the remains of Sergt. Charles Floyd, of the Lewis and Clark expedition.

No work was done during the fiscal year ending June 30, 1899.

During the past fiscal year definite progress has been made toward the early completion of this work. On May 5, 1900, the Secretary of War approved a project embodying a general design and method of procedure in erecting the monument in cooperation with the State of Iowa, which had also given $5,000 in aid of the work. (Act of the State legislature approved April 7, 1900.)

The foundation, consisting of a solid monolithic mass of concrete, was put in on the 28th of May. It is in the form of a frustrum of a pyramid, 22 feet square at the base, 13 feet 6 inches square at the top, and 11 feet high.

On the 31st of May bids were opened for the stone for the superstructure, and on June 26 a contract was entered into, on the part of the State of Iowa, with the Minnesota Sandstone Company, of Minneapolis, Minn., for furnishing the stone for the superstructure. The Kettle River sandstone was adopted.

Proposals are being advertised for, for the work of erection, and it is expected to lay the corner stone of the monument August 20, the anniversary of the death of Sergeant Floyd, and to complete the work before the end of October.

The style of monument selected is the Egyptian obelisk. Its height will be 100 feet 3¼ inches.

The details of the work will be deferred for the final report, which will be prepared after the completion of the monument.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	1,327.17
July 1, 1900, balance unexpended	3,672.83
July 1, 1900, outstanding liabilities	81.14
July 1, 1900, balance available	3,591.69

(See Appendix M M M.)

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1900, the following-named officers were on duty in this office as assistants:

Lieut. Col. Alexander Mackenzie.
Maj. Walter L. Fisk, from July 13 to September 23, 1899.
Maj. James L. Lusk.
Capt. James C. Sanford, from October 25 to December 20, 1899.
Capt. Joseph E. Kuhn.
First Lieut. Charles S. Bromwell, since April 6, 1900.
First Lieut. Spencer Cosby, from January 1 to February 21, 1900.

Very respectfully, your obedient servant,

John M. Wilson,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. Elihu Root,
Secretary of War.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

REPORT OF THE BOARD OF ENGINEERS.

THE BOARD OF ENGINEERS, ARMY BUILDING,
New York City, July 11, 1900.

GENERAL: I have the honor to submit the annual report recounting the operations of The Board of Engineers for the year ending June 30, 1900.

The following change in the personnel of the Board has taken place since the date of the last annual report:

Under the provisions of Special Orders No. 163, July 14, 1899, and No. 190, August 15, 1899, Headquarters of the Army, A. G. O., Lieut. (now Captain) Edgar Jadwin, Corps of Engineers, relieved Capt. William V. Judson, Corps of Engineers, as recorder and disbursing officer of the Board, the latter officer being ordered to duty in Porto Rico.

As at present constituted The Board of Engineers consists of the following-named officers of the Corps of Engineers: Col. Henry M. Robert, president; Col. John W. Barlow, Col. G. L. Gillespie; Capt. Edgar Jadwin, recorder and disbursing officer.

In addition Col. Peter C. Hains, Corps of Engineers, Division Engineer of the Southeast Division, and Col. Samuel M. Mansfield, Corps of Engineers, Division Engineer of the Pacific Division, are members of the Board when matters pertaining to defensive works in their respective divisions are under consideration.

The Board has considered the various subjects referred to it during the past fiscal year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1899.
July 3. On revised project for defense of the southern entrance to New York Harbor.
July 3. On design for armored range-finder shelters for battery commanders' stations for Forts Schuyler and Hamilton, N. Y.

1899.
July 3. On establishment of permanent fortifications upon Cape Henry, Virginia, at the entrance to Chesapeake Bay.
July 11. On amount of land required at Laguna Merced, California, to accommodate two mortar batteries projected there for the defense of the harbor of San Francisco.
July 28. On firings at Fort Washington, Md., June 29, 1899, against two experimental sections of parapets.
July 28. On revised project for the defense of Hampton Roads, Virginia.
July 28. On modification of the superior slope of the typical seacoast parapet.
July 28. On establishment of tide scales at military posts, for use with the depression position finder.
Aug. 7. On chain hoist for ammunition delivery for 8-inch B. L. R.
Sept. 12. On letter from Capt. W. C. Langfitt, Corps of Engineers, forwarding application of the Wolff and Zwicker Iron Works, of Portland, Oreg., requesting permission to use manganese bronze and steel forgings, instead of castings, under their contract for ammunition hoists for 6-inch rapid-fire guns
Oct. 5. On location of certain rapid-fire guns for the defense of Boston Harbor.
Oct. 7. Relative to revised project of the Board for the defense of Hampton Roads.
Oct. 9. On communication from the Naval War College relative to the construction of defenses at the Straits of Mackinac.
Oct. 13. On working drawings for the 10-inch B. L. R. ammunition hoist.
Oct. 26. On final report on transfers and repairs of old armament.
Nov. 20. On ballistic curves for 6-inch, 5-inch, 15-pounder, and 6-pounder rapid-fire guns.
Nov. 21. Relative to corrections in type plans for chain ammunition hoist for 6-inch rapid-fire gun.
Dec. 30. Submitting certain recommendations concerning construction of all future emplacements for high-power guns.
1900.
Jan. 17. On certain differences in number of gear wheels for 12-inch chain hoists being constructed by the Ellicott Machine Company of Baltimore, Md.
Feb. 1. On report of Capt. C. H. McKinstry, Corps of Engineers, dated St. Augustine, Fla., January 4, 1900, relative to the acquisition of land at St. Johns Bluff as a site for fortifications.
Feb. 1. On letter from Capt. Harry Taylor, Corps of Engineers, dated Seattle, Wash., January 17, 1900, on the advisability of the relinquishment of certain military reservations in the San Juan Islands.
Feb. 2. On the subject of modifying gearing in existing approved designs for chain ammunition hoists.
Feb. 28. On project for defense of the St. Johns River, Florida.
Mar. 8. On the retention of an island in the West Sound, Washington, for defensive purposes.
Mar. 12. On changes to be noted in the drawings of the Board's reports on 8 and 10-inch chain ammunition hoists.
Mar. 12. On revised project for defense of Boston Harbor.
Mar. 27. On application of Maj. S. W. Roessler, Corps of Engineers, for authority to use certain 69½-inch hold-down bolts in the mortar platform at Great Diamond Island, Maine.
Mar. 31. On mounts for 6-inch rapid-fire guns.
Apr. 6. On revised project for defense of Portsmouth, N. H.
May 10. On proposed bridge across Fort Point Channel, Boston, Mass.
May 18. Preliminary report for defense of the entrance to Chesapeake Bay at Cape Henry, Virginia, and the modification of existing projects for Baltimore, Md., and Washington, D. C.
June 6. On the subject of mounts for high-power guns.
June 11. On modifications in cover for high-power guns and mortars.
June 20. On design of Capt. H. F. Hodges, Corps of Engineers, for chain hoist for front delivery adapted for use in emplacements for 10-inch B. L. R. with 12-foot overhead cover.
June 20. On design of Mr. James Morris Morgan for a submarine boat for obstructing channels and harbors of entrance threatened by an enemy.

In the performance of the duties of The Board of Engineers the following inspections of localities were made during the past fiscal year:

On April 24, 1900, Colonels Barlow and Gillespie and Captain Jadwin, under instructions from the Chief of Engineers dated April 10, 1900, visited Cape Henry, Virginia, and inspected sites for the defenses in the locality, in connection with the preparation of a project for the defense of the entrance to Chesapeake Bay. Colonels Robert and Hains, by reason of other public duties, were unable to be present.

On May 4, 1900, the Board, consisting of Colonels Robert, Barlow, and Gillespie, with Captain Jadwin, under instructions from the Chief of Engineers dated April 24, 1900, visited Boston, Mass., for the purpose of inspecting the site for a proposed bridge across Fort Point Channel.

Under instructions from the Chief of Engineers, dated April 10, 1900, Captain Jadwin visited Fort Screven, Ga., April 17, 1900, and Fort Caswell, N. C., April 18, 1900, for the purpose of observing construction details in connection with the preparation of type drawings by The Board of Engineers. He also, on this same duty, visited Fort Dupont, Del., and Mott., N. J., June 29, 1900, under instructions from the Chief of Engineers dated June 22, 1900.

In addition to their duties with The Board of Engineers, the individual members of the Board have been engaged as follows during the year ending June 30, 1900:

Col. Henry M. Robert, president of The Board of Engineers, served continuously from July 1, 1899, to June 30, 1900, as Division Engineer of the Southwest Division, as ex officio member of the board of visitors to the United States Engineer School at Willets Point, N. Y., and as member and president of the following boards: (1) On harbor lines for the harbor of New York and its adjacent waters; (2) on harbor lines for the port of Philadelphia; (3) on examination of officers of the Corps of Engineers with a view to their promotion.

He still continues on all of the foregoing duties, and has, in addition, during the past fiscal year, served as member and president of a board to prepare and report project for a 35-foot channel throughout the Southwest Pass of the Mississippi River, and also was engaged on special duty in connection with the subject of providing dredges for the various seacoast harbors.

Col. John W. Barlow, Corps of Engineers, has continued to serve as Division Engineer of the Northwest Division. He has had charge of the improvement of Hudson River and harbors thereon, of rivers and harbors in northeastern New Jersey, and of Lake Champlain, New York and Vermont, of the making of certain surveys, of the removal of various wrecks, of the supervision of the construction of various bridges, of certain work of the Hudson Tunnel Railway Company, and of the construction of two piers on the Jersey Flats, New York Bay, Bayonne, N. J.

He has also served as a member of the following boards: Board of Officers for the examination for promotion of certain officers of the Corps of Engineers; Board of Engineers to make a survey and estimate of cost for the improvement of Upper Illinois and Lower Des Plaines rivers, Illinois; Board of Officers to investigate and report upon the subject of closing drawbridges across Passaic River and Newark Bay, New Jersey; Board of Officers to report upon harbor lines of New York Harbor and adjacent waters.

Col. G. L. Gillespie, Corps of Engineers, has continued to serve as Division Engineer of the Northeast Division; as member and president of the Mississippi River Commission; as member of Board of Engineer Officers to report upon the harbor lines of New York Harbor and adjacent waters; as member of Board of Officers for examination of officers of the Corps of Engineers for promotion, and as member of the Light-House Board.

Capt. Edgar Jadwin, Corps of Engineers, relieved Capt. W. V. Judson, Corps of Engineers, on August 16, 1899, as recorder and disbursing officer of the Board, in accordance with Special Orders, No. 163, July 14, 1899, and Special Orders, No. 190, August 15, 1899, Headquarters of the Army, Adjutant-General's Office, and has continued upon this duty since that date.

For the Board:

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX No. 2.

REPORT OF THE BOARD ON TORPEDO SYSTEM.

Board for Revision of the
Existing Torpedo System,
Willets Point, N. Y., July 20, 1900.

General: I have the honor to submit herewith annual report and summary thereof, in duplicate, upon the operations of the Board on existing torpedo system for the fiscal year ending June 30, 1900.

Very respectfully,

John G. D. Knight,
Major, Corps of Engineers, U. S. A.,
President of the Board.

Brig. Gen. John M. Wilson,
Chief of Engineers, U. S. A.

REPORT OF OPERATIONS OF THE BOARD FOR THE CONSIDERATION OF THE EXISTING TORPEDO SYSTEM FOR THE FISCAL YEAR ENDING JUNE 30, 1900.

The Board was constituted January 30, 1896.

By direction of the Chief of Engineers, United States Army, it examined and reported upon papers as follows:

1899.
Sept. 23. A blue print and description of a submarine mine, proposed by John A. Scholding, September 14, 1899.
1900.
Mar. 22. The invention of M. W. Hassan for induction signaling by mine torpedoes.
May 18. Modification of the invention of M. W. Hassan reported upon March 22.

The Board still has under consideration the subject of corrosion of certain material, referred to it June 15, 1900.

A change in the standard circuit regulator recommended by the Board was approved by the Chief of Engineers, United States Army, January 29, 1900, and the officer in charge of the United States Engineer Depot was informed thereof.

The officer in charge of the United States Engineer Depot has furnished the Board with copies of reports prepared by Lieut. Col. C. W. Raymond, Corps of Engineers, relative to five experimental mines planted in the Delaware River, July, 1899, and under observation about five months; and an extract from a report of Capt. W. C. Langfitt, Corps of Engineers, relative to submarine mining for defense of the mouth of the Columbia River.

Maj. John Millis, Corps of Engineers, prepared and submitted abstracts of reports of submarine mine defenses during the Spanish-American war, rendered to the Chief of Engineers, United States Army, by the various officers of the Corps of Engineers in charge thereof.

Studies, experimental work, and tests relating to improvements in details of the torpedo system suggested by experience had by these officers have continued.

Halpine torpedo.—So far as known, Lieutenant Halpine, U. S. N., retired, has taken no steps during the year toward delivering a torpedo. October 28, 1899, this Board was notified of the conditional intention of the Board of Ordnance and Fortification to revoke the allotment for the Halpine torpedo.

Change in personnel.—Maj. John Millis was relieved from and Capt. Henry Jervey detailed for duty as member of the Board, May 18, 1900.

The Board now consists of the following officers of the Corps of Engineers, stationed at Fort Totten, N. Y.:

Maj. John G. D. Knight.
Capt. Henry Jervey.
First Lieut. George P. Howell.

APPENDIX No. 3.

FORTIFICATIONS.

FISCAL YEAR 1889-1900.

3 A.

COAST OF MAINE.

Defenses of coast of Maine.—Officer in charge, Maj. Solomon W. Roessler, Corps of Engineers; assistants, Lieut. (now Capt.) Charles Keller, Corps of Engineers, to September 30, 1899, and Lieut. Thomas H. Jackson, Corps of Engineers, for the entire year; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

BAR HARBOR, ME.

Two 8-inch converted rifles and two 10-inch smoothbore guns were mounted on temporary wooden platforms for the defense of this point during the war with Spain in 1898. No repairs have been made during the year.

PENOBSCOT RIVER, MAINE.

A growth of brushwood has developed on the terreplein north of the fort proper, and was cut down several years ago. Having again grown to considerable height it was again cut down this year. The ordnance storeroom has been repaired, and some minor repairs have been made to the quarters of the ordnance sergeant. No work has been done on the armament, which was thoroughly overhauled in the preceding fiscal year.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$1,064.01
June 30, 1900, amount expended during fiscal year	369.40
July 1, 1900, balance unexpended	694.61

KENNEBEC RIVER, MAINE.

Four 15-inch smoothbore guns were mounted for the temporary defense of the river during the war with Spain in 1898. These have been dismounted and stored, the platforms taken up, and the ground leveled off. The present armament consists of one 8-inch B. L. rifle on a strengthened 15-inch smoothbore barbette carriage.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$220.24
Allotted July 5, 1899	300.00
Allotted July 24, 1899	1,200.00
	1,730.24
June 30, 1900, amount expended during fiscal year	932.15
July 1, 1900, balance unexpended	788.09

PORTLAND, ME.

Fort Gorges, Maine.—No work has been done during the fiscal year, excepting a few minor repairs to the quarters occupied by the watchman who has been kept on duty during the entire year.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$680.59
Allotted June 7, 1900	800.00
	1,480.59
June 30, 1900, amount expended during fiscal year	610.37
July 1, 1900, balance unexpended	870.22
July 1, 1900, outstanding liabilities	50.00
July 1, 1900, balance available	820.22

Fort Scammel, Maine.—No work has been done during the fiscal year. A watchman was kept at the fort during a part of the year, since which time the place has been visited daily by a man employed on the works at another locality, detailed for that purpose.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$862.94
June 30, 1900, amount expended during fiscal year	381.50
July 1, 1900, balance unexpended	481.44
July 1, 1900, outstanding liabilities	6.50
July 1, 1900, balance available	474.94

Site No. 1.—The modern fortifications constructed to date are a mortar battery mounting sixteen 12-inch mortars.

All the platforms are completed, all the base rings are set, all the carriages are assembled, and all the mortars are mounted. About 11,665 cubic yards of concrete have been placed. The electric-lighting plant and water supply have been installed. The ironwork, doors, etc., are in place. The flooring in Pit C is entirely finished, and all but a small part of the floor in Pit D is done. All the slopes around the four pits and a part of the parapet in front of Pit A have been graded and sodded. The two observation stations were raised 2 feet above the original level.

Under the allotment of $1,400 made August 23, 1899, the floors in the magazines and shell rooms of the battery were raised, properly graded, and connected by drains with the main drain. A ventilator was placed over the entrance to the storage-battery room. The work remaining to be done to complete the battery is as follows: Ledge excavation in rear of the pits, grading and sodding slopes, concreting floors in Pits A and B and part of Pit D, building concrete retaining walls in Pits A, B, and D so as to obliterate crumbling rock faces, grading and constructing roads in rear of all the pits, and the installation of electric fans for ventilating magazines.

For this work the allotment of $19,000 was made May 4, 1900, and work under this allotment was commenced June 1, 1900. During the month of June 1,409 cubic yards of ledge was excavated and removed, 262 cubic yards of fill placed, and 317 cubic yards of loam hauled; false works for retaining walls in Pit D, for intercepting drains, and for circular recesses around platforms have been erected. A gravity concrete mixer has been erected and a blacksmith shop fitted up.

The conditions of the shell rooms, and especially of the magazines, are very unsatisfactory, being kept quite wet from water filtering through the concrete. Plans are now under consideration to remedy this evil as far as it will be possible to do so.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended	$15,497.69
Allotted May 4, 1900	19,000.00
	34,497.69
June 30, 1900, amount expended during fiscal year	16,028.65
July 1, 1900, balance unexpended	18,469.04
July 1, 1900, outstanding liabilities	2,793.86
July 1, 1900, balance available	15,675.18

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended	$831.83
June 30, 1900, amount expended during fiscal year	99.10
July 1, 1900, balance unexpended	732.73

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$1,111.45
Allotted August 23, 1899	1,400.00
	2,511.45
June 30, 1900, amount expended during fiscal year	2,081.45
July 1, 1900, balance unexpended	430.00

Contracts in force during the fiscal year ending June 30, 1900.[1]

Name of contractor: John P. Cushing Company. (Electric lighting.)
Date of contract: May 1, 1899.
Date of approval: June 5, 1899.
Time for commencement: August 6, 1899.
Time for completion: October 5, 1899.

Name of contractor: Randall & McAllister. (For coal.)
Date of contract: May 24, 1899.
Date of approval: June 7, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

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[1] Contracts completed.

Name of contractor: W. L. Blake & Co. (Oils, waste, and grease.)
Date of contract: June 20, 1899.
Date of approval: July 13, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Berlin Mills Company. (Pipe and fittings.)
Date of contract: June 29, 1899.
Date of approval: August 4, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Berlin Mills Company. (For lumber.)
Date of contract: June 29, 1899.
Date of approval: August 4, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Site No. 2.—Fortifications constructed to date are Batteries B and C, mounting five 10-inch rifles on disappearing carriages, and one emplacement for 6-inch rapid-fire gun on pedestal mount. All of the guns are mounted.

During the past fiscal year additional work on Batteries B and C was done as follows: Floors raised in magazines and passageways; ventilators 1 foot in diameter placed in magazines and shell rooms of emplacements No. 2 of Battery B, and Nos. 1, 2, and 3 of Battery C; road in rear of battery lowered, graded, and macadamized; open brick drain constructed along the rear of roadway; two catch basins constructed; crumbling rock removed from rock face in rear of road; concrete retaining wall built in rear of emplacement No. 1 of Battery C; six observation stations erected; unfinished slopes graded and sodded and automatic locking device attached to lifts; alum and soap washes were applied to lessen the filtration of moisture.

The cost of the above repairs was $11,885.33.

The alum and soap wash has been effective in diminishing the amount of water filtering through the concrete, but has not completely excluded it. The ventilators in magazines and shell rooms are effective, greatly lessening the moisture in these rooms in fair or dry weather. When the wind is from the sea there may be an accumulation of moisture if the doors are left open. After some months' trial it has been found advantageous to close the doors of all rooms when the wind is from the sea and to open them for ventilation only when the wind blows from the land.

In addition to the above, two battery commanders' stations have been erected at a cost of $3,432.

Plans for electric lights are in preparation.

Money statements.

GUN AND MORTAR BATTERIES.

For emplacements.

July 1, 1899, balance unexpended	$1,167.41
Allotted June 14, 1900	500.00
	1,667.41
June 30, 1900, amount expended during fiscal year	1,167.41
July 1, 1900, balance unexpended	500.00
July 1, 1900, outstanding liabilities	91.67
July 1, 1900, balance available	408.33

Installation range and position finders.

July 1, 1899, balance unexpended	$9,000.00
June 30, 1900, amount expended during fiscal year	3,432.00
July 1, 1900, balance unexpended	5,568.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Allotted August 18, 1899	$12,000.00
June 30, 1900, amount expended during fiscal year	11,885.33
July 1, 1900, balance unexpended	114.67
July 1, 1900, outstanding liabilities	25.00
July 1, 1900, balance available	89.67

Site No. 3.—The following works have been authorized:

Battery for three 8-inch B. L. rifles on disappearing carriages, model of 1896 (first battery).

Battery for two 8-inch B. L. rifles on disappearing carriages, model of 1896.

A second battery for three 8-inch B. L. rifles on disappearing carriages, model of 1896.

Battery for two 12-inch B. L. rifles on disappearing carriages, model of 1896.

Mortar battery of eight 12-inch B. L. mortars.

Battery of two 6-inch rapid-fire guns on disappearing carriages.

Battery of two 15-pounder rapid-fire guns on balanced-pillar mounts.

Construction upon these batteries has been provided for as follows:

Six emplacements for 8-inch guns, six allotments aggregating	$317,000
Two emplacements for 8-inch guns, allotments aggregating	70,000
Two emplacements for 12-inch guns	119,000
Battery of eight 12-inch B. L. mortars, $125,000, less $9,000 transferred to two emplacements for 12-inch guns	116,000
Battery of two 6-inch guns on disappearing carriages	56,000
Battery of two 15-pounder guns on balanced-pillar mounts	10,000

Three emplacements for 8-inch guns on disappearing carriages (first battery).—At the beginning of the fiscal year the excavation, except for part of the roadway, had been completed, drains laid, the concrete brought up to the level of the loading platform, and carriages mounted.

During the year 2,722 cubic yards of concrete were placed, all ironwork, except hand rails, erected, 236 cubic yards of earth and 1,236 cubic yards of rock excavated from roadway, the roadway graded and surfaced with broken stone and granite screenings, and the fill commenced. The fill consists partly of stone chips and partly of sand with loam on top, the sand fill having a minimum thickness of 5 feet at the exterior crest and 6 feet and over near the concrete.

The most essential work required to complete this battery is as follows: Placing 1,300 cubic yards of sand fill and 910 cubic yards of loam, sowing grass seed, erecting hand rails, mounting guns, and removing plant and plunder. When this is done there will remain some loose spawls and rock near the right flank and in rear of the roadway, which must eventually be removed, but as this material can be used in grading the reservation when quarters are erected, it is thought its removal may properly be deferred until the place has been occupied by troops and the plan for the establishment of a post has been adopted. All the carriages are mounted and the guns are on hand.

Two emplacements for 8-inch guns on disappearing carriages.—At the beginning of the fiscal year all excavation, except 887 cubic yards from roadway, had been made, drains laid, concrete brought up to about the level of the loading platform, and carriages mounted.

During the year the concrete work was completed, all ironwork, except hand rails, erected, 887 cubic yards of rock excavated from roadway, roadway completed and surfaced, and fill completed and sown in grass. The battery is practically completed, except the erection of the hand rails, mounting of guns, and removal of plant.

The right flank of this battery does not rest upon ledge, and that more or less settling has occurred is evident from the unusual number of cracks that have appeared in the surface of the concrete.

Both carriages are mounted and the guns are on hand.

Three emplacements for 8-inch guns on disappearing carriages (second battery).—At the beginning of the fiscal year the concrete of emplacement No. 2 had been completed, excepting concrete walk in rear of traverse and one-half of one flight of steps. A small part of the ironwork had been erected and the fill nearly completed. At emplacement No. 1 the greater part of the excavation had been made, and at emplacement No. 3 all earth had been removed and about one-half the site had been drilled for blasting.

During the year at emplacement No. 1 the rock excavation was completed, drains laid, concrete work completed, and ironwork, except hand rails, erected. A waterproof course of asphalt, about 2 feet above the ceilings, was laid over all the rooms.

At emplacement No. 2 the fill was completed, ironwork, except hand rails, erected, and concrete on walk and steps completed.

At emplacement No. 3 all but 100 cubic yards of the rock excavation has been made, gun platform constructed, and parapet commenced, rubble masonry walls brought to floor level, and the walls of shot room, and guardrooms partly constructed.

Emplacement No. 2 in the battery, as now under construction, was No. 1 in the original plan. As this plan did not have sufficient room on the left flank for 6-inch guns, No. 1 and No. 2, which were the only emplacements upon which work had been done, were made Nos. 2 and 3, and the third emplacement was erected on the right. At the same time, to reduce rock excavation, the interior crest of No. 3 was raised 6 feet above that of Nos. 1 and 2. This change in the original plan has increased the quantity of fill for this battery by 7,400 cubic yards, and of concrete by 1,700 cubic yards, and decreased rock excavation by 3,000 cubic yards, with the net result of an increase in the cost of the battery; but the change was unavoidable, for the reasons stated. An additional allotment will be required to finish this battery. Two carriages and one gun are on hand.

Money statement.

GUN AND MORTAR BATTERIES.

Six 8-inch emplacements.

July 1, 1899, balance unexpended	$25,000.00
Allotted February 26, 1900	17,000.00
	42,000.00
June 30, 1900, amount expended during fiscal year	23,576.57
July 1, 1900, balance unexpended	18,423.43
July 1, 1900, outstanding liabilities	3,296.19
July 1, 1900, balance available	15,127.24

Two 8-inch emplacements.

July 1, 1899, balance unexpended	$61,911.93
June 30, 1900, amount expended during fiscal year	53,313.18
July 1, 1900, balance unexpended	8,598.75
July 1, 1900, outstanding liabilities	2,917.36
July 1, 1900, balance available	5,681.39

Two emplacements for 12-inch guns on disappearing carriages.—At the beginning of the fiscal year the excavation was completed, and concrete in emplacement No. 5 had been brought to the loading platform, except in parapet, where it had been brought to within 2 feet of the floor. Gun platform of No. 4 was completed, floors for rooms and magazines laid, and a portion of the parapet built to within 2 feet of the top. Both guns and carriages had been mounted.

During the fiscal year the concrete work was completed, slopes graded and sown in grass, some ledge removed in front of parapet, to bring the surface down below plane of fire, excavation for roadway, which is 14 feet below natural surface, completed so as to give a rear slope of 1 on 1, and a stone retaining wall 3 feet in height constructed up to the foot of the slope.

All that remains to complete this battery is the macadamizing of the roadway and the erection of the hand railing.

A waterproof course of asphalt and bitumen has been laid over the magazines and shell rooms of both emplacements. Both carriages and guns are mounted.

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended	$33,666.49
Transferred from mortar battery	9,000.00
	42,666.49
June 30, 1900, amount expended during fiscal year	41,241.93
July 1, 1900, balance unexpended	1,424.56
July 1, 1900, outstanding liabilities	597.88
July 1, 1900, balance available	826.68

Mortar battery.—At the beginning of the fiscal year 350 feet of 24-inch drain pipe and 150 feet of 36-inch brick drain had been constructed.

During the year 285 feet of 24-inch and 42 feet of 12-inch vitrified drain pipe have been laid, a 6-inch vitrified pipe has been laid the whole length of battery to carry off sewage from latrines, and 6-inch drains have been laid to connect mortar pits with main sewer. All drains are 5 feet or more below surface of contemplated roadway. The plant for crushing stone and mixing concrete has been erected, and about two-thirds of the concrete in the walls and covering of the east traverse have been placed. The floors in the rooms of the middle traverse have all been laid and the construction of the 20-foot wall of this traverse commenced. In all, 1,301 cubic yards of concrete have been placed.

The original estimate gave quantity as follows: Earth excavation, 8,000 cubic yards; rock excavation, 12,000 cubic yards; concrete, 9,200 cubic yards; fill, 26,000 cubic yards. The work done consists of 6,909 cubic yards earth excavation, practically all; 7,671 cubic yards ledge excavation, being all but about 400 cubic yards; 1,301 cubic yards concrete; and 1,128 cubic yards fill. The quantities in the original estimate are considerably in error, and are undergoing revision as the work progresses. The original estimate is also considerably in error as to prices, especially in the price of the fill, since the latter must be obtained by boats, from a distance, at a greatly increased cost over that of the earth, which it was thought would be obtained on the reservation.

Six carriages have been delivered, but no mortars.

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended	$115,482.49
Transferred to 12-inch battery	9,000.00
	106,482.49
June 30, 1900, amount expended during fiscal year	44,948.95
July 1, 1900, balance unexpended	61,533.54
July 1, 1900, outstanding liabilities	15,791.91
July 1, 1900, balance available	45,741.63

Battery of two 6-inch guns.—Construction had not commenced at the beginning of the fiscal year.

During the year all the earth and practically all the rock were excavated from the site of the battery and roadway, and as much of it as possible was used in the fill where the fill was deep and the use of such material thought to be admissible. The foundation walls of rubble masonry of emplacement No. 1 have been laid and the space between filled in with loose rock for receiving the concrete floors. The estimate for this battery included 2,000 cubic yards earth excavation, 3,800 cubic yards rock excavation, 5,900 cubic yards concrete, and 8,600 cubic yards fill. The first two items are considerably in error, the earth removed being only 675 cubic yards, in place of 2,000, as estimated, and the rock excavation being about 2,500, in place of 3,800, as estimated. Neither guns nor carriages are on hand.

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended	$56,000.00
June 30, 1900, amount expended during fiscal year	6,387.89
July 1, 1900, balance unexpended	49,612.11
July 1, 1900, outstanding liabilities	2,058.29
July 1, 1900, balance available	47,553.82

Battery of two 15-pounder rapid-fire guns.—The battery had not been commenced at the beginning of the fiscal year. The work during the year has consisted in excavation of rock and earth from the site of the battery and from the roadway which is to connect it with the 6-inch battery. All excavation except that for the drains has been completed and the excavated material placed in deep portions of the fill.

The location of this battery has been shifted 25 feet to the front of the point originally contemplated, because in the first position the field of fire toward the right flank would have been obstructed by the fill of the 6-inch battery. The alternative would have been to raise the crest of the 15-pounder battery 6 feet at a greatly increased cost over that for the more advanced site. As in other cases, the original estimate as to quantities of earth and rock is considerably in error, the quantity of earth removed being only 196 cubic yards, as against 700 cubic yards estimated, while the rock excavation will be 520 cubic yards, as against 360 estimated. Neither guns nor mounts are on hand.

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended	$10,000.00
June 30, 1900, amount expended during fiscal year	445.42
July 1, 1900, balance unexpended	9,554.58
July 1, 1900, outstanding liabilities	467.67
July 1, 1900, balance available	9,086.91

Water supply.—A steel tank of 21,000 gallons capacity at one locality has been erected under contract and connected with the system of mains previously installed. The water is obtained from an artesian well 261 feet deep, in rear of the 12-inch battery. The water supply at another locality is obtained from an artesian well 216 feet deep and is distributed from a wooden tank. The mains have not yet been laid in trenches.

General remarks.—The methods employed in building fortifications at this point are described in full in the latter part of the report herewith of Mr. Charles P. Williams, junior engineer and inspector, to which attention is invited for details.

The cost of the fortifications at this point has been seemingly high as compared with the cost of similar works at points in other districts, and higher than the original estimates under which the first allotments were made. Mr. Williams's report is very largely devoted to an analysis of the expenditures on the different batteries during the season of 1899 and the season of 1900 up to the end of the fiscal year. The tabular and descriptive statements contained in his report afford a more or less complete analysis of the cost of the different operations on these batteries; but to realize fully the situation at this point, and especially to comprehend why the cost of the works has been so high, certain features of the case not included in his report will be here stated.

The construction of fortifications on Site No. 3, commenced in 1897 under contract with Mr. William Morgan for building emplacements Nos. 4 and 5 of a 12-inch battery. The contractor abandoned the work in June, 1898, and left the bulk of it to be completed by the United States by day labor and at a necessarily higher cost than it would have been done for if completed by the contractor at contract prices.

In 1898 emplacement No. 2 of a battery of three 8-inch guns was started, in the near vicinity of the 12-inch battery, and under the National Defense fund. Both batteries were supplied from the same wharf and served by the same plant, and interference in the operations of one battery by the operations of the other battery were unavoidable. In all cases of such interference, on account of the time limit in which the National Defense fund could be used, the 8-inch battery was given the right of way, as far as possible, to the disadvantage of the 12-inch battery. How much the cost of the latter has been increased by these interferences can not be estimated in money, but it is not inconsiderable.

The stone excavated from the site of the 12-inch battery, which it was thought would be sufficient, when crushed, to make all the concrete that would be required in the battery, was much of it unfit for crushing, necessitating the purchase and delivery of stone from a distance to complete the work. The delivery of this stone was effected at an exceptionally high cost, from the fact that the arrangement of the plant was made on the supposition of using only the stone from the excavation and was poorly adapted to receive stone from the wharf economically. Furthermore, when stone deliveries were in progress it was impossible to carry on concrete work, which meanwhile had to be suspended. The cost of delivering stone from the wharf to crusher was 21 cents per ton, as compared with 18 cents per ton for the 8-inch battery and 15 cents for the mortar battery; and the cost of crushing was 53 cents per cubic yard, as compared with 26 cents for the 8-inch battery and 17 cents for the mortar battery.

The original estimate for this battery, including a preliminary allotment of $200, was $71,000. This was subsequently increased by three additional allotments to $119,000, all of which will be expended in completing the battery.

The next batteries constructed were the first battery for three 8-inch guns and a battery for two 8-inch guns, under the National Defense fund. The work was begun under the emergency existing at the time of the war with Spain. There were no wharf, roads, nor means of transporting articles at the time ground was broken. Work upon these was commenced as soon as possible. A systematic and economical prosecution of the work required that they should be completed before beginning the movement of heavy material, such as boilers, etc., but the emergency did not admit of so great a delay, and ground was broken with pick and shovel when the ground was still frozen and covered with snow; and steel rails, boilers, and other heavy material were landed upon the beach and hoisted with great cost and labor up the rocky slope to their position on the work. What was wanted was quantity of work rather than economy of construction, and the maximum rather than a minimum amount of labor was employed.

As the two batteries were too far apart to use one concreting plant for both, each battery was provided with a separate plant, in which, among other things, was a crushing outfit, on the supposition that the rock excavated from the site would be used in concrete. Only little of this native stone, however, proved fit for the purpose, the remainder being supplied by purchase at a considerably higher cost than would have resulted could the native stone already excavated have been used. Could the poor quality of the native stone have been foreseen, it would have been more economical in the end not to have erected crusher plants, but to have purchased stone already crushed.

The plants were erected under emergency and necessarily in great haste, and without that attention to details of design or arrangement which would require a minimum amount of labor to operate. As a result, the number of men required to run the plants was abnormally high. Later, when the emergency had passed, and with a view to economizing on labor as much as possible, the plants were remodeled, as far as it was practicable to do so, at some cost.

Both batteries were supplied from the same wharf and served by the same inclined railway, and though an attempt was made to carry on concreting operations on both at the same time—which was continued so long as the emergency existed—it was afterwards abandoned as needlessly costly on account of the frequent interference of operations on the two batteries with each other.

To expedite the work, during the emergency of the war, double shifts of men were employed and continued until November, 1898, but discontinued in 1898 because it was thought good honest work was not being obtained during the hours of darkness, owing to the ease with which men not working under the immediate eye of a foreman could and did shirk and neglect their work under cover of darkness in the early morning and late afternoon, and under the exceptional opportunities offered by the irregularities of the ground.

Weeks of delay in the delivery of cement resulted in expensive delays to the progress of the work and in a corresponding increase in the cost of concrete. The sand for concrete comes about 15 miles by sea from Saco River; the sand for fill comes from the same point, and the loam used as foundation for turf is brought in scows from the mainland. The average cost of sand used in concreting on the first battery for three 8-inch guns was $1.02 to $1.07 per cubic yard; on the battery for two 8-inch guns $1.01 to $1.06. The average cost of crushed stone, where stone was purchased and crushed, was, for the 3-gun battery, $1.83 per cubic yard, and for the 2-gun battery, $1.97. The average cost of sand used for fill was 92 cents per cubic yard for the 3-gun battery, and 94 cents for the 2-gun battery. Loam in place on the 3-gun battery has cost $2.27 per cubic yard and for the 2-gun battery $2.15.

Freight on cement in cargoes has ranged from 18 cents to 25 cents per barrel during the summer season and as high as 35 cents in the fall and early spring, thus making this cement considerably higher in cost than in other localities nearer the center of supply.

No systematic records showing the application of labor to the different batteries was kept up to 1898, and no value can therefore be assigned to the cost per unit of volume for excavation or concrete.

Another fact bearing upon the final cost is the price of labor in this vicinity. During the season of 1898 the minimum price of labor was $1.75 per day of 8 hours, being $1.65 for the labor proper and an allowance of 10 cents per working day for boat fare to and from the island. During the season of 1899 the minimum cost, including the 10 cents for transportation, was $1.60 per day, but the best labor could not be obtained for less than $1.75 per day. This high cost of labor is accounted for by the fact that in this latitude, owing to the severity of the winter climate and the almost complete suspension of outdoor work during the coldest part of the winter, the laborers' work for the whole year must be made during a period of about nine months.

After the commencement of the first battery for three 8-inch guns and the battery for two 8-inch guns in 1898, emplacement No. 2 of the second battery for three 8-inch guns was started, and this, being also under the national defense fund, was worked under the same pressure of that year's emergency, and under the same disadvantages as have been related for the other two 8-inch batteries.

To supply water needed for boilers, concreting, and other purposes, two wells were driven.

The second well was not completed until November, 1898, and until completed the water required was obtained from the first well by a 2½-inch pipe line 2,000 feet long between the well and the first battery for three 8-inch guns, with a branch pipe line 500 feet long to the battery for two 8-inch guns. This line was only temporary and its cost an unusual charge, since it was not required after the second well was completed.

Except in isolated places, where deposits of loam or clay existed to some depths, drains are laid in rock to depths ranging 4 feet or more below the surface, so as to lie below the action of frost. To lay even small drains under such conditions is a very expensive matter under the most favorable circumstances.

Consideration of the above facts and a realization of the expense in establishing a plant and of building track on irregular rock surfaces, and many other difficulties attending the prosecution of a work upon a rocky and difficult site, will explain in some measure at least the relatively high cost of these works.

The total amount allotted for the first battery for three 8-inch guns, the battery for two 8-inch guns, and emplacement No. 2 of the second battery for three 8-inch guns, all of which is needed, is $317,000.

Emplacements Nos. 1 and 3 of the second battery for three 8-inch guns have not been constructed under emergency as was emplacement No. 2, but they are supplied by the same plant, which was not well arranged at first and upon which a great deal of remodeling has been necessary to economize on labor and cheapen the work. The stone excavated from these emplacements has not been fit for crushing, and some of it has been handled twice. The allotment for these two emplacements, $70,000, is deficient. Between $11,000 and $12,000 more will be required to complete.

The allotment for the mortar battery was $125,000. From this $9,000 has been taken for the 12-inch battery, leaving only $116,000 available, which will not suffice to complete the work. The design and arrangement of the plant on this work are such as to minimize the cost of labor in handling and conveying material, and economical results will be shown in the final statement of the cost of this battery. But with the best of results as regards cost per unit of work, giving due consideration to cost of labor and material, the cost of the completed battery will necessarily be high. The difficulty of the site, which is on one side of a ravine, may be appreciated by mention of the fact that the depth of rock excavation at one end of the left traverse is 20 feet, and that from this point the rock slopes downward so as to require an excavation of 15 feet through clay to reach rock for the foundation walls at the other end of the traverse.

The 6-inch battery and the 15-pounder battery are being constructed under more favorable conditions, and, though errors have been discovered in the original estimates, it is now believed that these batteries will be completed within the allotments.

List of contracts in force during the fiscal year ending June 30, 1900.

Name of contractor: Atlas Cement Company. (Portland cement.)
Date of contract: April 18, 1898.
Date of approval: April 24, 1898.
Time for commencement: April 15, 1898.
Time for completion: November 1, 1898.

Name of contractor: Philip H. Doyen. (For moving stone.)
Date of contract: December 21, 1898.
Date of approval: January 9, 1899.
Time for commencement: Immediately.
Time for completion: At rate of 100 tons per working day.

Name of contractor: W. L. Blake & Co. (Oils, waste, and grease.)
Date of contract: June 20, 1899.
Date of approval: July 13, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Randall & McAllister. (For coal.)
Date of contract: May 24, 1899.
Date of approval: June 7, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Berlin Mills Company. (Pipe and fittings.)
Date of contract: June 29, 1899.
Date of approval: August 4, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Berlin Mills Company. (For lumber.)
Date of contract: June 29, 1899.
Date of approval: August 4, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Contracts closed.

REPORT OF CHARLES P. WILLIAMS, JUNIOR ENGINEER INSPECTOR, UPON OPERATIONS AT SITE NO. 3, PORTLAND HARBOR, MAINE.

Work has been in progress upon the following batteries:

Emplacements for three 8-inch B. L. rifles on disappearing carriages, model 1896 (first battery).

Emplacements for two 8-inch B. L. rifles on disappearing carriages, model 1896.

Emplacements for two 12-inch B. L. rifles on disappearing carriages, model 1896.

Emplacements for three 8-inch B. L. rifles on disappearing carriages, model 1896 (second battery).

Mortar battery of eight 12-inch B. L. mortars, model 1896.

Battery of two 6-inch rapid-fire guns on disappearing carriages, model 1898.

Battery of two 15-pounder rapid-fire guns on balanced-pillar mounts.

Construction upon these batteries has been provided for as follows:

Emplacements for six 8-inch guns:	
March 18, 1898	$150,000
August 16, 1898	90,691
February 27, 1899	4,309
March 16, 1899	30,000
June 28, 1899	25,000
February 26, 1900	17,000
	317,000
Emplacements for two 12-inch guns:	
March 15, 1897	200
March 27, 1897	70,800
August 13, 1897	2,200
August 16, 1898	36,800
October 30, 1899 (transferred from mortar battery)	9,000
	119,000
Emplacements for two 8-inch guns:	
July 16, 1898	70,000

Battery of eight 12-inch B. L. mortars:	
July 30, 1898	125,000
October 30, 1899 (transferred to 12-inch battery)	9,000
	116,000
Battery of two 6-inch rapid-fire guns:	
March 17, 1899	56,000
Battery of two 15-pounder rapid-fire guns:	
March 27, 1899	10,000

At the beginning of the fiscal year 1900 the status of the work was as follows:

First battery for three 8-inch guns: The concrete in all emplacements had been brought up to the level of the loading platform, and the false work was in place for the parapet of emplacement No. 1. The magazines of emplacements Nos. 1 and 2 had been covered with a waterproof course of asphalt and bitumen. All of the excavation on the site of the battery and the greater part of that in the roadway had been accomplished and the excavated material placed in the embankment, thus completing about one-half of the required fill. All drains had been constructed.

Armament: All carriages had been mounted and guns were on hand unmounted.

Battery for two 8-inch guns: The concrete up to the level of the loading platform had been placed in both emplacements and the false work for the parapet of emplacement No. 1 had been constructed. The magazines had been covered with a coating of asphalt and bitumen. Excavation, excepting a small amount of rock excavation in the roadway (887 cubic yards), had been completed. All drains had been constructed.

Armament: Carriages had been mounted. No guns were on hand.

Battery for two 12-inch guns: The excavation for this battery was completed. The concrete work of emplacement No. 5 was up to the level of the loading platform, except in the parapet, where it was up to within 2 feet of the finished surface. The gun platform was finished in emplacement No. 4, and floors for the rooms and magazines were also completed. That portion of the parapet immediately in front of the gun platform was finished to within 2 feet of the required height.

Armament: Both guns and carriages were mounted.

Second battery for three 8-inch guns: Emplacement No. 1: The greater part of the excavation had been completed. Emplacement No. 2: Concrete, with the exception of the concrete walks in rear of emplacement at loading-platform level, and about half of a flight of steps had been completed. A small part of the ironwork had been erected. The fill in parapet had been nearly completed. Emplacement No. 3: All earth had been excavated. About one-half of the site of the emplacement had been drilled for blasting during the working season of 1898.

Armament: No guns or carriages were on hand.

Mortar battery: Three hundred and fifty feet of 24-inch sewer pipe had been laid and 158 feet of 36-inch sewer constructed.

Armament: No mortars or carriages had been received.

Work had not begun upon the two 6-inch rapid-fire guns nor upon the two 15-pounder rapid-fire guns.

Water supply: Two wells had been driven and pumps installed. The foundation of a permanent water tank had been constructed and 4-inch mains laid from the site of the tank to the 12-inch battery, the second battery for three 8-inch guns, and the site of the mortar battery.

The work done in the fiscal year 1900 has been as follows:

First battery for three 8-inch guns: All concrete work has been completed, 2,722 cubic yards having been placed during the year. All but 24 cubic yards of this was placed during the working season of 1899.

All ironwork, excepting hand rails, has been erected.

Two hundred and thirty-six cubic yards of earth and 1,267 cubic yards of rock have been excavated from the roadway in rear of the battery. The roadway has been excavated to full width and to grade in rear of the entire battery and surfaced with a course of broken stone and granite screenings. The rock in rear of emplacements Nos. 1 and 2 has been taken off on a slope of 1 on 1½. This slope has not been carried out in rear of emplacement No. 3, and at present there are no funds available therefor.

The larger part of the military reservation being practically destitute of earth renders it necessary to use sand largely for embankments. Two thousand and four cubic yards of sand have been hauled from the wharf and placed in the fill.

About 1,160 cubic yards of loose rock derived from excavation has been placed in deeper portions of the fill. In order that a natural turf may be nurtured the sand fill is being covered with a layer of loam about 5 inches in thickness.

The work necessary to complete this battery is as follows: Placing 1,300 cubic yards of sand fill and covering the fill with 910 cubic yards of loam, sowing grass seed, erecting hand rails, mounting guns, and removal of plant and plunder.

Original estimates and estimated work done and to be done are as follows:

	Original estimate.	Estimated work done.	Estimated work to be done.
	Cubic yards.	*Cubic yards.*	
Earth excavation	4,039	4,236	Practically none.
Rock excavation	6,117	6,658	None.
Concrete	9,000	11,182	None.
Fill	12,060	9,970	Sand, 1,300 cubic yards; loam, 910 cubic yards.

Armament: The three carriages are mounted. The three guns are on hand, unmounted. All are in good condition.

The amount expended for superintendence and labor during the year is divided as follows:

Rock excavation, 1,267 cubic yards	$1,376.42
Earth excavation, 236 cubic yards	134.04
Rock fill, 1,160 cubic yards	820.93
Earth fill, 175 cubic yards	133.11
Sand fill, 2,004 cubic yards	286.14
Loam fill, 290 cubic yards	78.27
Surfacing roadway	37.52
Waste rock moved, 19 cubic yards	10.60
False work	1,230.67
Testing cement	197.43
Portland, traverse and parapet, 22 cubic yards	21.09
Finish, 363 cubic yards	803.57
Walks, 24 cubic yards	119.54
Rosendale, 2,313 cubic yards	2,218.85
Stone excavated for crushing, 999 cubic yards	957.44
Rock crushed, 3,024 cubic yards	600.78
Rock hauled from wharf, 2,152 tons	282.96
Sand hauled from wharf, 1,915 cubic yards	333.26
Cement hauled from wharf, 4,577 barrels	184.01
Waterproofing	60.06
Ironwork	847.24
Water supply	58.69
Drains	32.39
Floor drains	4.20
New plant	266.34
Repairing plant	552.97
Removing plant	63.80
Removing plant	99.32
Guns and carriages	204.75
Total	12,034.39

Battery for two 8-inch guns: All the concrete work has been completed, 7,356 cubic yards having been placed during the fiscal year 1900; of this, all but 15 cubic yards was placed in the working season of 1899. All ironwork excepting hand rails has been erected. The roadway in rear of the battery has been completed, 887 cubic yards of rock having been excavated therefrom. The roadbed was constructed of broken rock covered with granite screenings. Sand fill to the amount of 6,617 cubic yards was hauled from the wharf and placed. This was covered with a course of about 5 inches of loam, 869 cubic yards being required for this purpose. All of the fill has been sown in grass and a natural turf is forming.

The construction of the battery is now completed with the exception of the erection of iron hand rails. The guns remain to be mounted and the trestle used for hauling sand fill to be removed.

Original estimates and estimated work done and to be done are as follows:

	Original estimate.	Estimated work done.	Estimated work to be done.
	Cubic yards.	*Cubic yards.*	
Earth excavation	2,500	....	None.
Rock excavation	4,000	....	None.
Concrete	6,500	7,538	None.
Fill	14,000	16,887	None.

Armament: Both carriages are mounted and both guns are on hand. Both guns and carriages are in good condition.

The amount expended for supervision and labor during the year is divided as follows:

Rock excavation, 887 cubic yards	$810.94
Rock fill, 1,845 cubic yards	1,430.22
Earth fill, 26 cubic yards	22.75
Sand fill, 6,416 cubic yards	1,460.73
Loam, 869 cubic yards	660.47
Care of grass on fill	6.48
Waste rock moved, 12 cubic yards	6.24
False work	993.20
Portland, platform, 37 cubic yards	53.13
Traverse and parapet, 209 cubic yards	270.75
Finish, 262 cubic yards	720.66
Walks, 15 cubic yards	83.09
Rosendale, 1,831 cubic yards	1,885.06
Crushed rock hauled from "A," 1,529 cubic yards	220.44
Rock excavated for crushing, 145 cubic yards	136.01
Rock hauled from wharf, 1,463 tons	202.68
Sand hauled from wharf, 1,008 cubic yards	156.39
Cement hauled from wharf, 1,966 barrels	87.64
Testing cement	56.17
Waterproofing	116.60
Ironwork	742.14
Drains	40.44
Floor drains	31.65
New plant	221.02
Repairing plant	383.48
Moving plant	26.31
Removing plunder	21.20
Moving, mounting, and care of guns and carriages	305.10
Total	11,150.99

On January 13, 1900, an estimate was made of the amount necessary to complete the first battery of three 8-inch guns, the battery of two 8-inch guns, and emplacement No. 2 of the second battery of three 8-inch guns.

A comparison of this estimate, modified as per indorsement on letter of February 5, 1900, to the Chief of Engineers, with expenditures since January 13, 1900, is as follows:

Estimate, first battery for three 8-inch guns.

Railroad for placing sand fill	$150.00
7,800 cubic yards sand fill, hauled and placed, at $1	7,800.00
1,200 cubic yards loam, hauled and placed, at $2	2,400.00
Concrete walks in rear of emplacements at loading platform level	375.00
Erecting hand rails, etc	150.00
Removing plant and plunder	400.00
Mounting guns	400.00
Care and maintenance of guns and carriages	300.00
Incidentals, engineering, and supervision	1,775.00
Total	13,750.00

Estimate, battery for two 8-inch guns.

2,470 cubic yards sand fill, hauled and placed, at $1	$2,470.00
760 cubic yards loam, hauled and placed, at $2	1,520.00
Concrete walks rear of emplacements at loading platform level	250.00
Erecting hand rails, etc	100.00
Removing plunder	50.00
Mounting guns	250.00
Care and maintenance of guns and carriages	200.00
Removing waste rock on left of battery	360.00
Incidentals, engineering, and supervision	920.00
Total	6,120.00

Estimate, second battery for three 8-inch guns, emplacement No. 2.

Completing roadway in rear of battery	$150.00
Concrete walks in rear of emplacement at loading platform level	125.00
Erecting hand rails, etc	50.00
Mounting guns and carriages	300.00
Incidentals	50.00
	675.00

Estimate, water supply.

Water tank, steel	$1,000.00
Foundation for same	200.00
1,500 linear feet 4-inch cast-iron pipe, with hydrants, service boxes, water gates, bends, tees, lead, hemp, etc	800.00
Excavating, laying main, and back filling	1,500.00
	3,500.00

Expenditures since January 13, 1900, first battery for three 8-inch guns.

Pay of watchmen one-half of January, February, and March		$67.50
Roadway:		
Earth excavation, 27 cubic yards	$16.34	
Rock excavation, 601 cubic yards	713.75	
Surfacing	37.52	
		767.61
Fill:		
Earth and rock, 649 cubic yards	536.12	
Sand—		
Hauling and placing 2,004 cubic yards	286.14	
Liabilities for	1,402.80	
Coal	147.00	
Casco Bay S. Co. bill	5.00	
Loam—		
Hoisting, hauling, and placing 209 cubic yards	78.27	
Liabilities for	420.30	
Coal	71.00	
		2,946.63
Plant:		
Railroad	195.04	
Shovels	8.88	
Repairs	23.14	
		227.06
Waterproofing:		
Labor	18.11	
Paint (P. and B.)	3.30	
		21.41
Water supply		44.26
Concrete walks		119.54
Foundation plates, P and R finders		3.87
Drains		32.39
Floor drains		4.20
Care of guns (breech mechanism)		2.45
		4,236.92

Expenditures since January 13, 1900, battery for two 8-inch guns.

Pay of watchman, one-half of January and February		$45.00
Fill:		
Sand—		
2,483 cubic yards, hauling and placing	$824.80	
Bills for, certified	1,612.81	
Coal	55.00	
Other materials	3.08	
Rock, 22 cubic yards, and grading	53.72	
		2,549.41
Loam—		
869 cubic yards, hoisting, hauling, and placing	660.47	
Bills for, certified	1,014.65	
Liabilities for	234.88	
Coal	55.00	
Grass seed	13.30	
Earth excavated and placed, 26 cubic yards	22.75	
		2,001.05
Plant repairs		38.62
Guns and carriages—		
Mounting	17.46	
Receiving and hauling	5.35	
		22.81
Concrete walks and retaining wall		83.09
Floor drains		31.65
Care of grass on fill		6.48
Removal of plunder		21.20
Foundation plates for P. and R. finders		2.91
		4,802.22

Expenditures since January 13, 1900, second battery for three 8-inch guns, emplacement No. 2.

Foundation plates, P. and R. finders	$0.97	
Grass seed	1.30	
		$2.27

No expenditure has been made upon water supply.

Twelve-inch battery: All the concrete work has been completed, 11,896 cubic yards having been placed. A one-half inch layer of asphalt and bitumen waterproofing was placed over the magazines, shell rooms, and traverse galleries of each of the emplacements of this battery at the level of the loading platforms, with a pitch of one-fourth inch to 1 foot toward the air spaces, the concrete being prepared for it by floating a thin layer of mortar over it in order to make smooth surfaces.

In front of the parapet, ledge has been excavated to bring the surface down to the proper elevation, and the earth originally excavated from the site has been used in grading. At the rear of the battery the excavation for the roadway, which is about 14 feet below the natural surface, has been extended so that a 1 to 1 slope could be made, and a stone retaining wall 3 feet in height has been constructed at the foot of this slope. Grass seed has been planted on all of the slopes.

All that remains for the completion of this battery is the macadamizing of the roadway and the erection of the hand railing at the rear of the loading platforms.

The original estimate and estimated amounts of work done and to be done are as follows:

	Original estimate.	Estimated work done.	Estimated work to be done.
	Cubic yards.	*Cubic yards.*	
Rock excavation	7,250	8,085	None.
Concrete	8,000	11,896	Do.
Grading fill	1,000	1,296	100 cubic yards.
Ironwork		[a]97	3 per cent.

[a] Per cent.

Armament: Both guns and carriages are on hand, mounted and in good condition.

The amount expended for labor and supervision during the year is divided as follows:

Rock excavation, 985 cubic yards	$1,895.83
Earth excavation, 307 cubic yards	187.70
Rock fill	12.10
Earth fill grading, 652 cubic yards	734.46
Rear slope, 117 cubic yards	88.77
Retaining wall, 117 cubic yards	329.82
Roadway rear of battery	140.75
Care of grass on fill	31.86
False work	2,059.40
Testing cement	168.99
Portland, platform, 72 cubic yards	199.66
Traverse and parapet, 1,788 cubic yards	2,044.45
Finish, 421 cubic yards	1,552.24
Steps to observation station	3.15
Rosendale concrete, 1,132 cubic yards	1,360.69
Rock crushed, 2,609 cubic yards	1,382.43
Rock hauled from wharf, 3,222 tons	682.64
Sand hauled from wharf, 1,853 cubic yards	380.23
Cement hauled from wharf, 2,500 barrels	156.28
Removing surface of Emplacement No. 5	39.70
Ventilators, Emplacement No. 5	44.25
Waterproofing	64.10
Ironwork	1,222.10
Drains	21.14
Floor drains	13.92
Water supply	18.70
General plant	6.37
Repairing plant	1,033.63
Moving plant	37.05
Removing plant	301.01
Guns and carriages	259.98
	16,473.40
Deduct on account of 215 tons stone delivered to second battery for three 8-inch guns	215.00
	16,258.40

Second battery for three 8-inch guns: The work done upon this battery has been as follows:

Emplacement No. 1: Rock excavation was completed, the excavated material being placed in the fill. Drains, including main drain in roadway, were laid. Concrete work upon this emplacement was begun July 25, 1899, and completed June 7, 1900. A waterproof course of asphalt and bitumen, about 2 feet above the level of the ceilings, was laid over all rooms. Iron ladders and about one-half of the doors have been erected.

Emplacement No. 2: The remainder of the fill in front of this emplacement was placed. Ironwork was erected, and the concrete steps leading from the loading platform to the traverse gallery were completed.

Emplacement No. 3: Rock excavation for this emplacement was practically completed on February 1, 1900. About 100 cubic yards was left as it was immediately under the trestle used for concreting. This remains to be taken out. This season the concrete in the gun platform has been placed, and a section of the parapet about 10 feet square has been carried up to the approximate level of the top of the parapet and is used as a derrick foundation. The traverse between the shell room of emplacement No. 1 and the air space of emplacement No. 2 has been brought up to a height about 2 feet below the level of the gun platform. Rubble masonry walls and concrete floors have been put in and the walls of the shot room and guardroom partly constructed.

Since the beginning of work upon this battery the following changes have been made in the plan of construction:

At the time of the location of the battery of two 6-inch rapid-fire guns it was found necessary, in order to make room for these guns, to move the location of the battery a distance to the eastward along the line of the longitudinal axis equal to the distance between two gun centers. At the time this change was made one emplacement provided for by an allotment from the appropriation for "National Defense," and originally intended for emplacement No. 1, had been partly constructed. This emplacement by the change became emplacement No. 2. It is estimated that this change increased the quantity of fill by 5,800 cubic yards, increased the quantity of concrete by 900 cubic yards, and decreased the quantity of rock excavation by 1,600 cubic yards.

A second change in the plan of construction raised the level of emplacement No. 3 a distance of 6 feet. This brought about the following changes in quantities: Eight hundred cubic yards more concrete, 1,600 cubic yards more fill, and 1,400 cubic yards less rock excavation.

Modifying original figures to conform to above changes, the estimated quantity of work done and to be done is as follows:

	Original estimate.	Modified estimate.	Estimated work done.	Estimated work to be done.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*	*Cubic yards.*
Earth excavation	2,500	2,500	1,171	None.
Rock excavation	6,000	3,000	5,919	100
Concrete	5,000	6,700	4,683	2,165
Masonry			110	295
Fill	5,500	12,900	1,107	5,490

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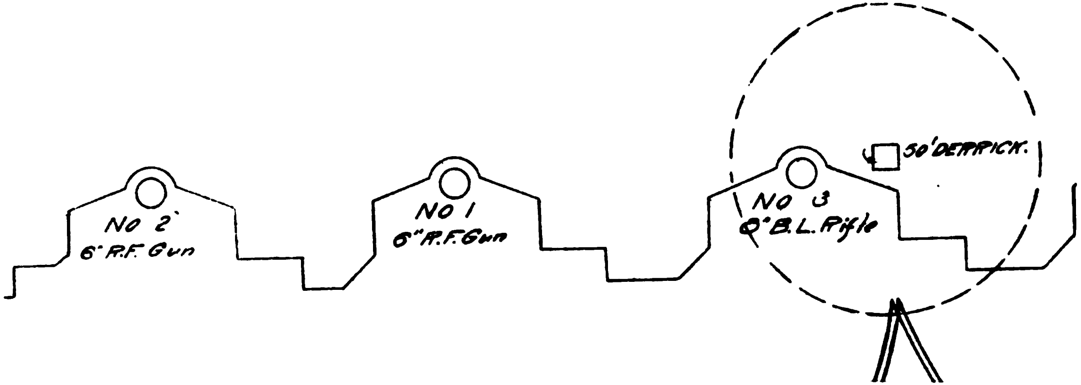
Armament: Three 8-inch carriages are on hand in good condition, except one of the distance rings, which has been so badly bent in transportation that it will have to be returned to the shop to be straightened before it can be assembled with the carriage.

On emplacement No. 2 the base ring is in its position on the gun platform.

One gun has been received. It is in good condition and placed near the site of the battery.

The amount expended for labor and supervision during the year is divided as follows:

Rock excavation, 4,728 cubic yards		$6,416.88
Earth excavation, 14 cubic yards		7.26
Rock fill		65.91
Fill under floors		10.90
Earth fill, 1,007 cubic yards		676.90
Roadway rear of battery		8.10
False work		2,490.92
Testing cement		477.13
Portland, walls, 201 cubic yards		437.25
Traverse and parapet, 702 cubic yards		626.43
Platform, 779 cubic yards		777.07
Finish, 218 cubic yards		620.47
Rosendale, 2,780 cubic yards		1,984.99
Rock crushed, 3,457 tons		911.88
Rock hauled from wharf, 5,491 tons		969.15
Sand hauled from wharf, 274 cubic yards		410.86
Cement hauled from wharf, 9,228 barrels		441.48
Coal hauled, 90 tons		16.31
Rubble masonry, 110 cubic yards	$307.79	
Hauling brick	5.90	
		354.30
Waterproofing		155.05
Laying brick over asphalt		21.18
Water supply		205.52
Drains		170.76
Ironwork		632.28
Office buildings		97.13
New plant		725.36
Repairing plant		558.68
Concrete plant		1,539.91
General plant		344.82
Moving engine to wharf		24.65
Removal of plant		57.53


NO 2
6" R.F. Gun
NO 1
6" R.F. Gun
NO 3
6" B.L. Rifle
50' DERRICK.

Moving gun and carriages	$295.74
Mounting carriage	130.18
Care of guns and carriages	93.70
	22,756.68
Add on account of 215 tons stone received from the 12-inch battery	215.00
	22,971.68

Mortar battery: The main drain has been completed, 285 linear feet of 24-inch and 42 feet of 12-inch vitrified pipe having been laid, also a 6-inch vitrified-pipe sewer running the whole length of the battery for the purpose of carrying the sewage from latrines. Six-inch vitrified drains have also been laid from the mortar pits and rooms to the main drain. These drains are in no case less than 5 feet below the contemplated finished surface of the roadway. A derrick for use in rock excavation was erected, and a gravity railroad for transporting the excavated rock to the dump was constructed. A concrete plant consisting of mixing plant and plant for crushing stone was erected.

Excavation has been practically completed. There remains to be taken out the earth on the site of the western powder magazine and shell room and also trenches for foundation walls under these rooms as well as for the exterior 5-foot wall in rear of the middle traverse. In the latter case it will be necessary to excavate to a depth varying from 8 to 14 feet below the floor level to obtain a suitable foundation. The rock excavation remaining to be done is about 400 cubic yards on the site of the pit for the four western mortars. Mixing and placing concrete upon this battery began May 28. About two-thirds of the concrete in the walls and covering of the rooms in the eastern traverse has been placed; also the floors of the rooms in the middle traverse as well as a part of the 20-foot wall of that traverse which is used for a foundation for a derrick. In all 1,301 cubic yards of concrete have been placed.

There are at the present time stored upon the mortar battery 1,730 barrels of Portland cement, 3,438 barrels of Rosendale cement, 1,334 cubic yards of sand, and 1,717 tons of granite for crushing.

All of the roof beams have been purchased and are upon the site.

The original estimate and the estimated work done and to be done are as follows:

	Original estimate.	Estimated work done.	Estimated work to be done.
	Cubic yards.	*Cubic yards.*	
Earth excavation	8,000	6,909	
Rock excavation	12,000	7,671	About 400 cubic yards.
Concrete	9,200	1,301	
Fill	26,000	1,128	

Armament: Six carriages for 12-inch B. L. mortars are on hand all in good condition. No mortars have yet been received.

The amount expended for labor and supervision during the year, is divided as follows:

Stripping ledge	$439.38
Rock excavation, 7,671 cubic yards	10,718.55
Earth excavation, 6,305 cubic yards	4,220.78
Excavation for sewer	265.28
Rock fill, 226 cubic yards	95.68
Rock fill under floors	150.94
Earth fill, 1,025 cubic yards	474.99
False work	1,629.78
Testing cement	212.07
Portland, walls, 515 cubic yards	433.07
Floors 128 cubic yards	88.94
Platform, 227 cubic yards	186.42
Traverse, 123 cubic yards	75.40
Finish and face, 111 cubic yards	248.95
Rosendale, 197 cubic yards	200.95
Rock crushed, 1,113 cubic yards	193.55
Rock hauled from wharf, 3,578 tons	607.67
Sand hauled from wharf, 2,507 tons	199.97
Cement hauled from wharf, 5,949 barrels	311.20
Hauling coal	16.10

Waterproofing, 262 square yards	$24.91
Ironwork	72.86
Drains	448.87
Rubble masonry	503.27
Concrete plant	2,679.20
Rock excavation plant	2,178.85
General plant	429.87
Moving plant from "B"	344.07
Moving mortar carriages	509.59
Care of mortar carriages	13.00
	27,974.16

An analysis of all expenditures upon the mortar battery since the beginning of its construction, is as follows:

Main drain		$3,516.19
Drains		3,138.56
False work		2,365.53
Water system		686.52
Clearing site		1,637.80
Fill, labor		651.59
Plant		9,496.76
Carriages		418.87
Earth excavation		6,399.54
Rock excavation:		
Labor	$10,451.99	
Material	2,689.96	
		13,141.95
Concrete work:		
Labor	2,774.29	
Material	9,116.79	
		11,891.08
Metal work:		
Labor	72.86	
Material	4,190.46	
		4,263.32
Waterproofing:		
Labor	24.91	
Material	96.49	
		121.40
Rubble masonry:		
Labor	503.27	
Material	777.25	
		1,280.52
United States Engineer Office		1,735.01
"Cora"		553.46
		61,298.10

Allotment	116,000.00
Expenditures	61,298.10
Available	54,701.90

Labor	35,082.83
Plant, etc	26,215.27
	61,298.10

Battery of two 6-inch guns: All of the earth and practically all of the rock was excavated from the site of this battery and roadway. A large part of this has been placed in the fill in such positions as have been heretofore indicated. The foundation walls of emplacement No. 1 have been laid in rubble granite masonry and loose stone filling has been placed between these walls for the reception of the concrete floors. One thousand three hundred and nineteen barrels of Rosendale cement have been received preparatory to concrete work. Roof beams, ladders, and iron door frames have been purchased and are on hand.

The reference of this battery was raised 9 feet above that originally contemplated.

The original estimate, modified estimate on account of raising the crest 9 feet, estimate of work done, and estimate of work to be done, are as follows:

	Original estimate.	Modified estimate.	Estimate of work done.	Estimate of work to be done.
	Cubic yds.	*Cubic yds.*	*Cubic yds.*	*Cubic yds.*
Earth excavated	2,000	2,000	675	....
Rock excavated	6,500	3,800	2,316	197
Concrete	5,000	5,900	None.	....
Earth fill	4,000	8,600	None.	....

Armament: No guns or carriages are on hand for this battery.

The amount expended for labor and supervision, since January 22, 1900, at which time work commenced on this battery, is divided as follows:

Clearing site	$21.64
Rock excavation, 2,316 cubic yards	3,779.52
Earth excavation, 703 cubic yards	388.08
False work	4.60
Rubble masonry, 83 cubic yards	124.41
Water supply	24.05
Hauling drainpipe	1.44
Iron work	5.36
Plant	258.10
Hauling cement, 1,319 barrels	58.71
	4,665.91

An analysis of all expenditures is as follows:

Expenditures to July 1, 1900.

Clearing site, labor		$21.64
Earth excavation, labor		388.08
Rock excavation:		
Labor	$3,779.52	
Material	515.78	
		4,295.30
Rock plant:		
Labor	138.92	
Material	24.64	
		163.56
General plant:		
Labor	54.13	
Material	129.61	
		183.74
Concrete plant:		
Labor	65.05	
Material	212.22	
		277.27
Water supply, labor		24.05
Rubble masonry, labor		124.41
Concrete work, labor		58.71
False work, labor		4.60
Iron work:		
Labor	5.36	
Material	971.90	
		977.26
Drains:		
Labor	1.44	
Material	128.88	
		130.32
United States Engineer Office, materials		2.40
		6,651.34

Labor	$4,665.91
Material	1,985.43
	6,651.34
Allotment	56,000.00
Expended	6,651.34
Available	49,348.66

Two 15-pounder rapid-fire guns: Work upon this battery has consisted in excavating earth and rock from the site of the battery and from the roadway leading from the battery of two 6-inch guns. All excavation except that for drains has been completed, and the excavated material has been placed in the embankment.

The location of this battery has been shifted 25 feet to the front from that originally contemplated. This change was made necessary by the change in level of the battery of two 6-inch guns. In order that a projectile from the right 15-pounder gun at the limit of fire should not strike the embankment of emplacement No. 2 of the 6-inch battery, it was necessary to raise the reference of the contemplated battery of two 15-pounders 6 feet or move it 25 feet to the front. The first expedient being very costly, the latter was adopted.

The original estimate of quantities, estimate of work done and to be done, are as follows:

	Origiual estimate.	Estimated work done.	Estimated work to be done.
	Cubic yds.	*Cubic yds.*	
Earth excavation	700	196	None.
Rock excavation	360	471	50 cubic yards.
Earth fill	2,700	None.	
Concrete	900	None.	

Armament: No guns or mounts have been received.

The amount expended for labor and supervision since May 8, at which time work upon this battery began, is divided as follows:

Clearing site	$68.48
Rock excavation, 471 cubic yards	654.95
Earth, 196 cubic yards	154.91
General plant	8.61
False work	17.80
Total	904.75

An analysis of all expenditures is as follows:

Expended to July 1, 1900.

Clearing site, labor		$68.48
Earth excavation, labor		154.91
Rock excavation:		
Labor	$654.95	
Materials	8.34	
		663.29
General plant, labor		8.61
False work		17.80
Total		913.09
Labor		904.75
Material		8.34
Total		913.09
Allotment		10,000.00
Expended		913.09
Available		9,086.91

Water supply: A steel tank of 21,000 gallons capacity has been erected under contract and connected with the system of mains already installed.

METHODS EMPLOYED AND RESULTS ATTAINED.

First battery for three 8-inch guns and battery for two 8-inch guns: It was found impracticable to carry on concrete work to any great extent on both batteries at the same time. One crushing plant was used for the two batteries, while each had its own mixing plant. Materials for both batteries were hauled from the same wharf. A railroad track led directly from the wharf to the plant on the three-gun battery. Materials were hauled over this track by means of a hoisting engine and cable. A branch track from the main line operated by an additional hoisting engine led to the two-gun battery.

The crushing plant used consisted of a No. 5 Champion crusher driven by a 30-horsepower portable engine, and a stone bin of 180 cubic yards capacity. Crushed stone used for concrete on the three-gun battery was drawn directly from this bin, while that used on the battery for two 8-inch guns was conveyed in dump cars to a storage bin on the site of that battery. The inferior character of the native stone rendered it necessary to purchase stone for crushing. During the season of 1899 granite was delivered in dump cars on the wharves at $1 per ton of 2,000 pounds. The average cost of hauling this to the crusher upon the south side was 13 cents per ton. The cost of crushing was 20 cents per cubic yard of crushed stone. The cost of hauling from the bin at the crusher to the storage bin at the two-gun battery was 14 cents per cubic yard. This gave an average price of crushed stone at the three-gun battery of $1.83 per cubic yard, and at the battery for two guns of $1.97 per cubic yard.

The price of sand delivered in dump cars upon the wharf varied from 85 cents to 90 cents per cubic yard. The average cost of hauling sand per cubic yard to the battery for three 8-inch guns was 17 cents, and to the battery for two 8-inch guns was 16 cents.

Cement for these batteries was used as follows:

Battery for three 8-inch guns:	
1,000 barrels Portland "Vulcanite," at $2.35	$2,350.00
574 barrels Portland "Atlas," at $2.20	1,262.80
1,643 barrels Rosendale "Brooklyn Bridge," at $1.13¾	1,868.91
1,360 barrels Rosendale "Brooklyn Bridge," at $1.10	1,496.00
Total	6,977.71
Battery for two 8-inch guns:	
500 barrels Portland "Atlas," at $2.50	1,250.00
626 barrels Portland "Atlas," at $2.20	1,377.20
840 barrels Rosendale "Brooklyn Bridge," at $1.10	924.00
Total	3,551.20

The average cost per barrel of hauling cement to the battery for three 8-inch guns was 4 cents, and to the battery for two 8-inch guns was 4½ cents.

The cost of coal prior to January 1, 1900, was $3 per ton of 2,000 pounds, delivered in cars. Since that date 50 tons at $4.40 and 27 tons at $4 have been purchased.

The cost of hauling has been 12 cents per ton.

The method employed on both batteries for mixing and placing concrete was as follows: Concrete of the proportions of 1 part cement, 2 parts sand, and 4 parts broken stone was used. For face work and for finished surfaces cement mortar 1 part cement and 2 parts sand, was used. Materials were assembled in a charging car of capacity sufficient to carry a 1-barrel charge of concrete, the stone being delivered directly from the bin into this car and the cement and sand being conveyed from the cement shed and sand bin in smaller cars, which were dumped into the larger one. The sand was shoveled from the bin into the small sand cars. After being assembled, the charging car was pulled up an incline to a platform above the mixer and discharged into a hopper, whence it was dumped into the mixer. After mixing, the concrete was discharged into a dump car, hauled to the work, and distributed by means of wheelbarrows. On the three-gun battery 409 cubic yards of Portland concrete was mixed and placed at an average cost of $2.31 per cubic yard for labor, including engineering and supervision, and 2,313 cubic yards of Rosendale concrete at an average cost of 96 cents per cubic yard.

Concreting was practically completed during the working season of 1899.

Deliveries of sand for filling began upon the two-gun battery October 6, 1899. Between that date and November 30 2,277 cubic yards were taken, at a price of 65 cents per cubic yard, delivered in cars upon the wharf, and one load of 200 cubic yards was delivered upon the wharf at 25 cents per cubic yard.

On December 1, 1899, deliveries began at a price of 70 cents per cubic yard, delivered in cars. Since that time 3,939 cubic yards have been hauled and placed in the fill on the battery for two guns, and 2,004 cubic yards on the battery for three guns.

The average cost of hauling and placing in the fill, including engineering and supervision, coal, and all necessary materials, has been 22 cents per cubic yard upon the three-gun battery and 24 cents per cubic yard upon the two-gun battery.

Loam for covering sand fill has been purchased at $1.45 per cubic yard, delivered at the vessel's side. The cost of hoisting, hauling, and placing has been 82 cents per cubic yard on the two-gun battery and 70 cents per cubic yard on the three-gun battery. The high cost of hoisting, hauling, and placing loam is attributable to the fact that the thickness of the course is only 5 inches, which renders the labor of placing large in proportion to the quantity placed.

Twelve-inch battery, second battery for three 8-inch guns, mortar battery, and batteries of two 6-inch guns, and two 15-pounder rapid-fire guns: During the working season of 1899 concrete work was in progress upon the 12-inch battery and battery for three 8-inch guns only; this season it has been in progress upon the 8-inch battery and mortar battery only. All of the materials for these batteries, with the exception of sand and cement for the 12-inch battery, were taken from a stone wharf. The road leading from this wharf has a grade of 13 per cent for a distance of about 270 feet, after which the roads leading to the various batteries are comparatively level. This renders it necessary to use a hoisting engine over the steep grade, after which the cars are taken by a locomotive and hauled to their destination. The locomotive haul to the 12-inch battery is about 500 feet, to the 8-inch battery and the 6-inch battery 1,200 feet, and to the mortar battery 1,000 feet. Sand and cement for the 12-inch battery were taken from a wharf from which the cars were hauled direct by means of a hoisting engine, the distance being about 300 feet.

During the season of 1899 materials were delivered at the same prices as quoted in connection with the first battery for three 8-inch guns and the battery for two 8-inch guns. This season materials are being delivered at prices as follows: Sand, 65 cents per ton, delivered in cars; stone, 98 cents and $1.10 per ton, delivered in cars; Atlas Portland cement, $2.27 per barrel; Vulcanite Portland cement, $2.35 per barrel; Brooklyn Bridge Rosendale cement, $1.11 per barrel, delivered at the vessel's side.

The average cost of hauling sand from the wharf to the storage bin has been, on the 12-inch battery, 20 cents per ton; on the 8-inch battery, 13 cents per ton, and on the mortar battery, 9 cents per ton.

As nearly as possible stone is crushed at the same time as it is being hauled from the wharf. In order to prevent delays, however, it is necessary to keep a large supply of stone on hand. The average cost of hauling stone to the 12-inch battery has been 21 cents per ton; to the 8-inch battery, 18 cents per ton, and to the mortar battery, 15 cents per ton.

The average cost of hauling cement to the 12-inch battery was 6 cents per barrel; to the 8-inch battery, 5 cents per barrel, and to the mortar battery, 5 cents per barrel.

The average cost of crushing stone per cubic yard of stone crushed has been, on the 12-inch battery, 53 cents per cubic yard; on the 8-inch battery, 26 cents per cubic yard, and on the mortar battery, 17 cents per cubic yard.

Twelve-inch battery.—The methods employed upon this battery were as follows: Stone was received in skips on the cars at the wharf and taken up the roadway to the rear of the battery. From this point a derrick placed the stone near the crusher, which was located at the edge of the bluff immediately in front of emplacement No. 4. This derrick was also used in placing concrete in emplacement No. 4, so that the receipt of stone and the placing of concrete could not go on simultaneously. A No. 5 Champion crusher was used, and crushed stone was stored in an inclosure located immediately south of the mixer. This inclosure had a floor about 25 feet below the elevation of the crusher and had a capacity of about 600 cubic yards. From it the stone used in concrete was taken when required. Sand was received in cars on the temporary wharf, and being drawn up an elevated track, was dumped in a pile immediately north of the mixer. Cement was received in barrels on cars at the wharf and taken to the shed located immediately east of the mixer. A revolving 5-foot cubical mixer was used, operated by a small engine (7½ inches by 6 inches), geared direct by means of spur gearing. The sand and stone were handled by means of bucket conveyors, each being placed in bins directly over the mixer. The bins had a capacity of 10 cubic yards for stone and 5 cubic yards for sand. Immediately under these bins were two measuring hoppers for stone and sand, respectively, and an additional hopper for cement. From these measuring hoppers the charge was dumped into the mixer and thence, when mixed, into a car immediately under it. This car delivered the mixed batch by means of a hoisting engine and an inclined track to the site of the battery under one of the two 55-foot derricks at emplacements No. 4 and No. 5, respectively, which placed it in the work at the point required. Two barrels of cement, 16 cubic feet of sand, and 32 cubic feet of stone constituted a batch for both Portland and Rosendale concrete.

The usual number of men engaged in the operation of mixing and placing was as follows: Two master laborers, 3 steam engineers, 2 stokers, and 25 laborers. With this force, 200 barrels of cement could be readily mixed and placed in the work in eight hours. The largest number mixed in eight hours during the season was 228 barrels.

The greatest drawback to the economical working of this plant was the inability to receive stone and place concrete at the same time. The introduction of a sand bin and a stone bin so arranged that each would have discharged sufficient at least for a single day's work would also have greatly reduced the cost of construction by saving the labor of the men who were needed under the existing arrangement in supplying the bucket conveyors with sand and stone.

The cost of the labor of mixing and placing the various kinds of concrete was as follows:

	Per cubic yard.
Portland platform	$2.77
Traverse and parapet	1.15
Finish	3.69
Rosendale	1.20

The variance in the cost of materials and the fact that an indefinite amount of the stone used for crushing was excavated from the site of the battery makes it impracticable to give the cost of materials per cubic yard of concrete.

Upon the 8-inch battery the methods employed for excavating rock were as follows:

On emplacement No. 1 the entire amount of excavated material was placed in the fill, being wheeled in barrows. About one-third of the embankment for this emplacement was thereby placed.

On emplacement No. 3 there was a comparatively small amount of fill required and a greater amount of excavation. As the rock was unfit for crushing, it was disposed of by being dumped into the bay. A double-track railroad having two balanced cars was constructed for this purpose. The loaded car on one track in running down grade to the shore pulled the empty car back to the site of the battery. The rock was wheeled from the pit where excavation was in progress and dumped into these cars, the wheel in no case being over 100 feet.

Upon concrete work the methods employed during the season of 1899 were much the same as have already been described in remarks upon the first battery for three 8-inch guns and the battery for two 8-inch guns.

Stone hauled from the wharf was dumped from the cars upon the crusher platform. A No. 5 Champion crusher, driven by a 30-horsepower portable engine, was used for crushing. A bucket elevator conveyed the stone to a stone bin of 120 cubic yards capacity. The sand inclosure, which had a capacity of about 200 cubic yards, consisted simply of a floor resting on the ground and bounded on one side by the mixer engine house and on two sides by close fences 4½ feet high. The railroad track ran at one side of the inclosure and at the level of the top of the fence. The greater part of the sand received had, therefore, to be trimmed over by shovels. Materials were conveyed to the mixer by means of a charge car. The crushed stone was delivered direct into this car through a sliding door in the bottom of the stone bin, and the cement and sand were conveyed to it by means of small dump cars. The materials being assembled, the charge car was hauled to the platform above the mixer and dumped into a hopper and thence into the mixer. The same hoisting engine which hauled the materials to the mixer platform hauled the concrete, when mixed, to the battery, whence it was distributed by means of wheelbarrows. The mixer used was a 5-foot cubical box, driven by a 25-horsepower engine. To assemble the materials and mix and deliver the concrete on the shoveling board at the battery required ordinarily 2 engineers, 1 stoker, and 8 laborers. Four men were ordinarily employed shoveling into barrows. The remainder of the crew depended to a large extent upon the nature of the work in hand and the distance of the work from the shoveling board. This distance never exceeded 100 feet. The amount of concrete which could be placed per day with this plant varied greatly with the nature of the work. In placing Rosendale concrete in the parapet, 100 cubic yards were placed per day for four consecutive days.

The average cost of labor in mixing and placing the various kinds of concrete was as follows:

	Per cubic yard.
Portland walls	$2.18
Traverse and parapet	.89
Platform	1.00
Finish	2.85
Rosendale	.71

The average cost of labor on false work per cubic yard of concrete was 53 cents. It must be stated in this connection, however, that all saddles for supporting false work had been made in construction of previous work upon 8-inch emplacements, thus materially reducing the cost. The larger part of the pine lumber used had also been used before and required considerable labor in order to fit it for use.

Attention is called to the method employed in waterproofing the rooms of emplacement No. 1. The rooms under the loading platform, as well as those under the traverse, were covered with a one-half inch waterproof layer of asphalt and bitumen. The concrete upon which this was based was given a slope toward the air space of about 1 foot in 10 feet and floated with mortar as a preparation for the asphalt layer. Upon the asphalt layer were placed a cheap quality of brick spaced about one-fourth inch apart. These spaces were filled with sand, and upon this brick course the concrete above was based. The cost of asphalting per square yard was—

Materials	$0.68
Labor	.25
Total	.93

Foundation walls were also asphalted below the floor level. The same care was not taken in this case to obtain a smooth surface upon which to apply the asphalt, in consequence of which the cost was somewhat higher—viz., materials, 81 cents; labor, 36 cents; total, $1.17. Floors were sloped toward drains in the center of rooms with a grade of 1 inch in 5 feet. Floors were 6 inches in thickness, underlaid with loose stone, filling 1 foot or more in depth.

Some very important modifications were made in the plant at the beginning of this season's work.

These changes consisted in the introduction of a sand bin of a capacity of 250 cubic yards, about 100 cubic yards of which would discharge by gravity into the charge car, the latter amount being sufficient for from two to three days' work. The sand, when hauled from the wharf, was delivered at a point in front of the bin and dumped into a hopper, from which a bucket conveyor elevated it to the sand bin. As sand was delivered at fairly regular intervals of two or three days, this bin disposed of the question of sand storage and brought the labor required to handle the sand down to the minimum, only one laborer being employed at this work, and he in addition handled the stone and cement placed in the charge car.

A 50-foot derrick was also erected to cover the work on emplacement No. 3, which disposed of the men formerly employed in handling the concrete. A track was laid from the mixer and from the main line over which materials were hauled from the wharf to a point under the derrick from which it is proposed to handle all the material used in the construction of this emplacement.

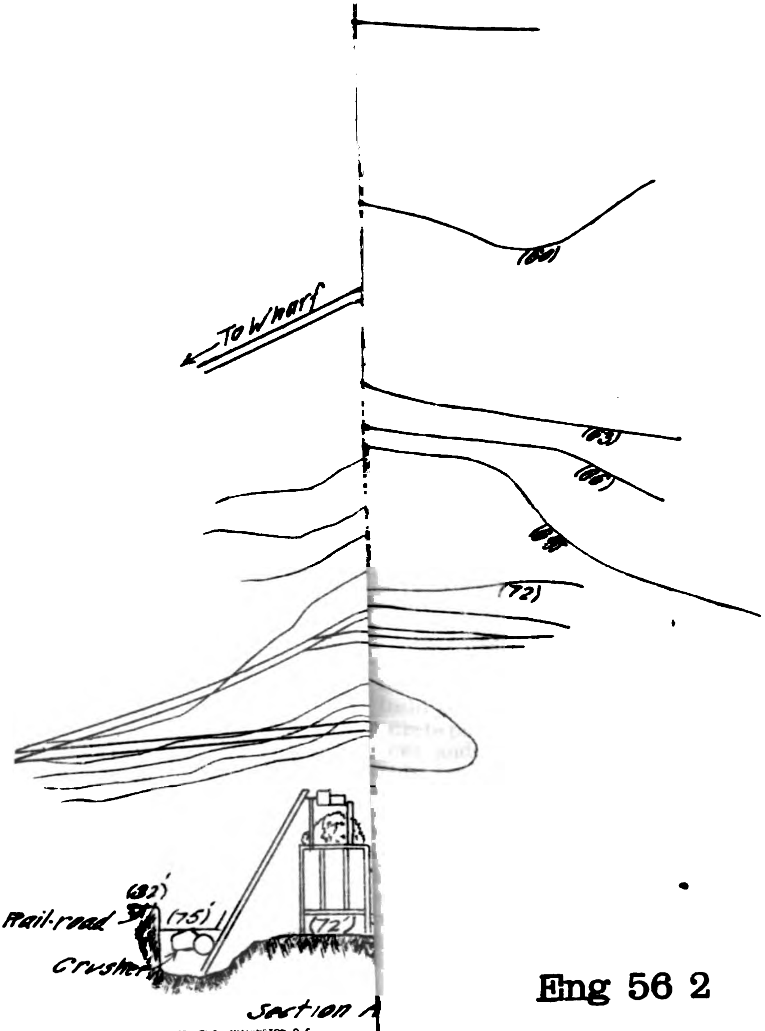
The machinery for operating the 5-foot cubical mixer was also changed from worm wheel to spur gearing, and the engine (25-horsepower) was replaced with a 7½-inch by 6-inch vertical engine geared direct to the mixer. This change dispensed with one 40-horsepower upright boiler which is now held in reserve.

The number of men required to operate the concrete plant under the present system is as follows: Two master laborers, 1 steam engineer, and 16 laborers. This force can readily mix and place 200 barrels of cement in eight hours.

In the construction of emplacement No. 3, the floor drainage system differed materially from the other emplacements. In each of the rooms 2-inch gutters were made in the floors close to the walls of the rooms, the floors being raised in the middle of the rooms and sloping toward the gutters, from which pipes opened into a 2-foot air space. The bottom of the air space sloped from either end of the emplacement toward the point where it crossed the transverse axis of the gun, and at that point a 6-inch drain extended to the drain in the roadway at the rear of the battery. An opening was left so that access could be had to the air space, and the entire drainage system can be cleaned or repaired as may be required.

Granite rubble masonry laid in 1 : 2 Rosendale cement mortar is being used in the walls of the rooms of this emplacement, back of the air space the masonry being

Sketch of Concrete Plant for Mortar Battery



THE NORRIS PETERS CO., PHOTO-LITHO. WASHINGTON, D. C.

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carried to the level of the roof beams. The cost of rubble masonry has been as follows, per cubic yard:

Labor	$3.22
Cement	1.29
Sand	.32
Stone	1.89
Total	6.72

Mortar battery: The greater part of the earth excavation upon this battery was done during the last working season. It was wheeled in barrows to points where embankments were contemplated. Rock excavation began October 21, 1899. A derrick was erected for this work. Since the excavated rock was unfit for crushing, it became necessary to remove it entirely from the site of the battery. For this purpose a double track gravity railroad similar to that used upon the second battery for three 8-inch guns was devised, running from a point within reach of the derrick to a dump. With this plant from 75 to 100 cubic yards per day could be excavated and removed. The average cost per cubic yard of solid rock excavated, including engineering and supervision, dynamite, exploders, coal, and all necessary materials, was $1.71.

The site of the mortar battery is located immediately back of a high ridge. For this reason it was necessary to excavate rock at certain points along the front of the battery to the depth of 20 feet, while at certain points along the line of the rear wall it was necessary to excavate earth to a depth of 15 feet below the floor level in order to found the walls upon rock. It was necessary to excavate to that depth in the walls of the relocating room on the left of the battery, the walls on one side being 10 feet in thickness, and owing to the nature of the clay in this excavation a great part of the core between the wall trenches had also to be removed. Since the bottom of this excavation was below the level of the main drain, a steam siphon had to be kept in constant operation to keep the pit free from water. This excavation was necessarily costly.

The concrete plant upon the mortar battery consists of one No. 5 Champion crusher with elevator and screen for which power is furnished by a 30-horsepower engine with boiler combined, a stone bin of 180 cubic yards capacity, one cylindrical mixer 5 feet in diameter and 6½ feet long turned by a 25-horsepower engine, one double-drum hoisting engine used for hauling cement, sand, and crushed stone to the platform above the mixer and also for operating the car which carries the mixed concrete to the battery, one 60-horsepower boiler, and two 55-foot derricks for placing concrete.

A sketch herewith shows the general arrangement of the plant.

In mixing, the materials are assembled in a charge car which is then pulled up an incline to the platform above the mixer. This car is of sufficient capacity to carry before mixing 2 barrels of cement, 16 cubic feet of sand, and 32 cubic feet of crushed stone. These are the quantities used for one charge of Rosendale concrete. For Portland concrete one-barrel charges are used. The materials are assembled in the charge car in the following manner: Crushed stone is discharged directly from the stone bin into a measuring box; by opening a door in the lower end of this measuring box the stone is discharged directly into the charge car; sand is shoveled from the storage pile into small measuring dump cars which, after being filled, are pushed to the point where the materials are assembled and dumped into the charge car; cement is dumped into a small hopper above and on one side of the charge car and discharged into it at the proper moment by means of a trap door. In this manner the materials are collected and are ready to be discharged into the charge car the instant it returns to the lower end of the incline.

Cement is opened in the immediate vicinity of the 60-horsepower boiler, and the barrel staves are used exclusively for firing this boiler and to a large extent for firing the crusher-engine boiler. These two boilers are so connected that either may be used for operating the entire mixing or crushing plant.

In carrying mixed concrete from the mixer to the battery, two flat cars, each carrying a skip of 50 cubic feet capacity, are used. While a loaded skip is being placed by the derrick the empty one is being handled back to the mixer for another charge. One derrick only has been in use for concreting. The second is being erected and will soon be ready for use. The one in use has a 12-foot bull wheel and swinging gear of the type manufactured by the American Hoist and Derrick Company. This wheel and gear has given perfect satisfaction. The derrick in process of erection is to be operated by a Lidgerwood hoisting engine and will be fitted with the bull wheel and swinging gear manufactured by that company.

In eight hours concrete to the amount of 141 cubic yards, after tamping, has been mixed and placed with this plant. Concrete work upon this battery began May 28, 1900. The cost of mixing and placing the various kinds of concrete upon this battery during the month of June was as follows:

	Portland.					Rosendale—traverse, 1:2:4.
	In floors, 1:4:8.	In walls, 1:3:5.	Walls, 1:4:8.	Platform, 1:3:5.	Finish and face work.	
Cement	$1.75	$2.87	$1.75	$2.87	$5.87	$1.74
Sand	.45	.54	.45	.54	.98	.45
Stone	1.79	1.79	1.79	1.79	....	1.79
Labor	.69	.84	.84	.75	2.24	.97
	4.68	6.04	4.83	5.95	9.09	4.95

The higher cost of the labor of mixing and placing Rosendale concrete in traverse is due to the fact that it was for a derrick foundation and had to be wheeled in barrows.

The mortar battery is located in a well-protected position. For this reason it was decided to use in walls Portland concrete of the proportion 1 : 4 : 8; for 2 feet over ceilings, Portland concrete 1 : 3 : 6; over this, Rosendale concrete 1 : 2 : 4, and on the more exposed parts of outside walls and traverse, Portland concrete 1 : 3 : 6. Though the final strength of 1 : 4 : 8 Portland concrete in walls will probably be inferior to 1 : 2 : 4 Rosendale concrete, it is believed that it will be ample, and on account of the great load to be carried by the walls shortly after their construction a comparatively early strength was desired.

Ample storeroom exists in the mortar battery for the storage of sand and stone. Sand is dumped from a high trestle into the sand pile and railroad tracks are so disposed as to allow stone to be dumped on the crusher platform or stored in the immediate vicinity.

Two 6-inch guns: In excavating rock upon the two 6-inch guns one of the tracks which had been used for carrying excavated material from the second battery for three 8-inch guns to the dump was extended into the pit where excavation was in progress, and the rock was shoveled and thrown directly into the cars. These cars were run down to the shore by gravity and hauled back to the site of the excavation by a hoisting engine and cable. About one-half of the rock excavated was thus disposed of, while the remainder was placed in the embankment. The average cost of excavating rock on this battery, including engineering and supervision and the purchase of dynamite exploders and all other material, was $1.85 per cubic yard.

Foundation walls for emplacement No. 1 of this battery were constructed of rubble granite masonry, laid in 1 to 2 Rosendale cement mortar. The cost of this masonry was $4.60 per cubic yard.

Two 15-pounder rapid-fire guns: The earth and rock excavated from the site of the battery has been wheeled in barrows and placed in the embankment. The average cost of excavation, including engineering and supervision and cost of all materials, was for earth 79 cents per cubic yard, and for rock $1.65 per cubic yard.

Previous to October 7, 1899, Mr. W. F. Robinson, Assistant Engineer, was in charge of the construction of fortifications at this site. Last season work upon the 12-inch battery, and since April 1, 1900, upon the second battery for three 8-inch guns and batteries for two 6-inch guns and two 15-pounder rapid-fire guns, was under the immediate supervision of Mr. Charles R. Hall, overseer.

Site No. 4—Emplacements Nos. 3 and 4 for two 12-inch rifles on disappearing carriages.—The site of these emplacements was a rock ledge with but few inches of soil upon the surface. The battery is of the half-sunken type, and required the removal of a large amount of rock in preparing the site, in excavation for the road, and in laying deep drains that should lie below the action of frost. Much of the rock so removed will be crushed and used in making concrete.

At the beginning of the fiscal year the excavation for emplacement No. 4 and that for the main drain had been nearly completed, and the excavation for emplacement No. 3 about 75 per cent completed. During the fiscal year the excavation for both emplacements, roadway, and drains was completed; 1,342 cubic yards of Portland and 640 cubic yards of Rosendale concrete have been placed; 240 linear feet of vitrified sewer pipe of main drain laid in concrete, 300 linear feet of small interior drain pipe laid, and 800 cubic yards of rock fill placed under floors of rooms and over drains. The emplacement for No. 4 has been brought up above platform level. All the rooms are protected against filtration of moisture by a layer of Neuchatel rock asphalt which collects the moisture and sheds it into the air spaces.

Emplacements Nos. 3 and 4 for two 10-inch rifles on disappearing carriages.—The site is a rock ledge. The battery is of the half-sunken type, and the rock excavation has been considerable. The location is near the crest of the main ridge, but between the crest and the sea. To overcome as far as possible the objection of having a high rock face in rear of the battery, the crest of the battery has been raised 6 feet above the level originally specified. This has been done at some increase in the cost of the battery, since much of the excavation had been completed for the lower elevation before the crest had been raised.

At the beginning of the fiscal year the site had been cleared, 6,365 cubic yards of loose rock and earth removed, 11,929 cubic yards of solid rock excavated, and excavations for drains practically completed. During the fiscal year the excavation has been completed by the removal of 1,622 additional cubic yards of rock ledge; 2,400 cubic yards of rock fill have been placed; 427 feet of main drain and 270 feet of interior drain pipe have been laid in concrete; 1,198 cubic yards of Portland and 1,237 cubic yards of Rosendale concrete have been placed, and all floors completed. Emplacement No. 4 has been brought up above roof level.

Emplacement No. 2, for one 12-inch rifle on disappearing carriage.—Excavation was commenced in August, 1899, and continued throughout the year. By the close of the fiscal year about 95 per cent of the excavation and about one-half of the drainage system had been completed.

Three emplacements for 15-pounder rapid-fire guns on balanced pillar mounts.—The site is reached from the heavy batteries by a railroad about 1,100 feet in length. Work on the road was constructed in September and October of 1899. The rock excavation for the battery was commenced in November, 1899, and completed in May, 1900. The excavation amounted to about 2,000 cubic yards. By the end of the fiscal year nearly all the floors had been constructed, drain pipes laid, and concreting commenced.

For further details attention is invited to the accompanying report of Lieut. Thomas H. Jackson, Corps of Engineers, who has had local charge of these works during the year.

Money statements.

GUN AND MORTAR BATTERIES.

Two 12-inch emplacements.

July 1, 1899, balance unexpended	$70,898.80
Allotted May 4, 1900	17,000.00
	87,898.80
June 30, 1900, amount expended during fiscal year	43,959.08
July 1, 1900, balance unexpended	43,939.72
July 1, 1900, outstanding liabilities	6,430.79
July 1, 1900, balance available	37,508.93

Two 10-inch emplacements.

July 1, 1899, balance unexpended	$55,740.34
Allotted May 4, 1900	26,000.00
	81,740.34
June 30, 1900, amount expended during fiscal year	44,081.77
July 1, 1900, balance unexpended	37,658.57
July 1, 1900, outstanding liabilities	5,441.91
July 1, 1900, balance available	32,216.66

One 12-inch emplacement.

July 1, 1899, balance unexpended	$52,000.00
June 30, 1900, amount expended during fiscal year	16,768.07
July 1, 1900, balance unexpended	35,231.93
July 1, 1900, outstanding liabilities	992.10
July 1, 1900, balance available	34,239.83

15-pounder battery.

July 1, 1899, balance unexpended	$13,000.00
June 30, 1900, amount expended during fiscal year	7,978.80
July 1, 1900, balance unexpended	5,021.20
July 1, 1900, outstanding liabilities	336.25
July 1, 1900, balance available	4,684.95

List of contracts in force during fiscal year ending June 30, 1900.

Name of contractor: Randall & McAllister. (For coal.)
Date of contract: May 24, 1899.
Date of approval: June 7, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: W. L. Blake & Co. (Oils, waste, and grease.)
Date of contract: June 20, 1899.
Date of approval: July 13, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Berlin Mills Company. (Pipe and fittings.)
Date of contract: June 29, 1899.
Date of approval: August 4, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.

Name of contractor: Berlin Mills Company. (For lumber.)
Date of contract: June 29, 1899.
Date of approval: August 4, 1899.
Time for commencement: At once.
Expiration: December 31, 1899.
Contracts closed.

REPORT OF LIEUT. THOMAS H. JACKSON, CORPS OF ENGINEERS.

The work done previous to June 30, 1899, and the plant constructed and in use, were given in my last annual report. During the past year work has been continued on that already begun on a third 12-inch emplacement and on a battery of three 15-pounders.

All work was done with the same plant and under the same conditions. As far as possible it has been carried on continuously at all points, though during the winter months little was done on the two 12-inch and on the two 10-inch emplacements.

The work on the installation of a crushing and mixing plant was begun in June, 1899, and completed in time to begin concreting about September 11, 1899. There were many long delays experienced in the installation of this plant, due to the difficulty in obtaining machinery, and these delays caused great delay on the 10-inch battery and added much to its cost. Two 4-foot cubical mixers, a No. 5 Champion crusher, a stone bin, capacity 350 cubic yards, two stationary and one double-drum hoisting engines, all operated by a 60-horsepower boiler, and the necessary elevators, conveyors, and inclines constitute this plant.

The following is its cost:

Crushing plant:	
Crusher and toggles	$1,328.25
Auxiliary shaft, pulleys, belts, etc	224.75
Engine and fittings (40 horsepower)	339.86
Elevator screens, etc	794.19
Track for handling rock	491.00
Material entering construction	104.53
Labor employed in installation	544.88
	3,827.46
Stone and sand plant:	
Material used in stone bin	535.38
Labor employed in construction	818.61
Sand cars and track	436.39
	1,790.38
Mixing plant:	
Mixers	700.00
Auxiliary shaft, pulleys, belts, etc	101.48
Engine fittings	30.00
Cars for handling dry material	336.80
Material used in incline, platform, and engine house	416.69
Labor employed in construction and installation	348.63
	1,933.60
Total cost	7,551.44

The rock excavated is a hard, fine-grained granite, and about 17,000 cubic yards of this have been broken to convenient sizes for the crusher and hauled and dumped near it.

The uncertainty in regard to sand deliveries has made it impossible to depend on the limited supply that a bin would hold, so sand is dumped in a large pile near the stone bin. The cost of sand in the pile last year was 90 cents per cubic yard, and this year it will be about 85 cents per cubic yard. Concrete is mixed and placed as follows:

The incline to the mixer platform runs under the stone bin and the tops of the cars are on a level with the surrounding surface. The cement and sand are run in on cars and dumped into these cars, while the stone is drawn directly from the bin. After it is mixed the concrete is dumped into skips on flat cars, and hauled by 10-horsepower locomotives to the emplacements where the skips are handled by derricks. Concrete work was suspended on November 20, 1899, and resumed on April 30, 1900. Rock work, however, was continued throughout the winter, excavation being made on the third 12-inch emplacement, on the 15-pounder battery, and on the roadway connecting the 10-inch and 12-inch batteries.

The scarcity of water at this point has been a source of great trouble and expense. Salt water was used last season in the concrete placed in the parapet and below the floor levels, and for four months all the water used in the boilers had to be brought from Portland in tanks. Two wells, one 540 feet and the other 200 feet deep, have been drilled, but no water has been obtained.

Emplacements for two 12-inch rifles on disappearing carriages.—The work on these emplacements consisted of the completion of the rock excavation, 3,112 cubic yards being excavated and removed; the placing of 800 cubic yards of rock fill; the laying in concrete 240 feet of main drain (8-inch, 10-inch, and 12-inch vitrified sewer pipe), and 301 feet of interior drain pipe (3-inch and 4-inch pipe); the placing of 1,342 cubic yards of Portland concrete, 640 cubic yards of Rosendale concrete, 198 cubic yards of Portland mortar, and 160 cubic yards of large stone; the construction of all the false work for the rooms, gun wells and platforms, breast-high wall, and other false work; the construction of all the doors and windows, all the floors in No. 4, and the placing of an asphalt layer in the walls below the floor level in No. 4, and another layer about 18 inches below the platform level covering the entire emplacement.

The following is the cost of drains:

Pipe, strainers, and manhole covers	$356.11
Cement and sand	277.06
Labor employed in placing pipe and filling drain	528.04
Total	1,161.21

No cost of the drains due to excavations can be given, but the added cost to the battery, due partly to the excavation and partly to the rock which is blasted out and replaced by concrete, will be at least as much as the cost given above.

The following is the cost of excavation:

Plant	$7,719.63
Installation	1,753.57
Repairs and maintenance	1,204.37
Material used in excavation (coal, dynamite, etc.)	3,609.85
Labor employed in excavation	28,650.59
	42,938.01
Earth and loose rock, 5,745 cubic yards at 81 cents	3,653.45
Solid rock, 15,897 cubic yards at $2.41	39,284.56
Total, 21,642 cubic yards at $1.984	42,938.01

At the close of the fiscal year all excavation was completed, about 20 per cent of the fill had been made, all drains were laid, and emplacement No. 4 was completed up to the platform level.

Emplacements for two 10-inch rifles on disappearing carriages.—The work on these emplacements during the past year consisted of the completion of the rock excavation, 1,682 cubic yards being excavated and removed; the placing of 2,400 cubic yards of rock fill; the completion of the drainage system, 427 feet of main drain (8-inch, 10-inch, and 12-inch vitrified sewer pipe) and 270 feet of interior drains (3-inch and 4-inch vitrified sewer pipe) being laid in concrete; the placing of 1,198 cubic yards of Portland concrete, 1,237 cubic yards of Rosendale concrete, 224 cubic yards of Portland mortar, and 80 cubic yards of large stone; the construction of all the floors; the construction of the false work for the rooms, gun wells, gun-platform steps, breast-high wall, and other fixed forms; the construction of the doors and windows, and the laying of an asphalt layer in the walls about a foot below the floor level. Also the handling of and caring for the two guns and carriages which have been received.

Cost of drains exclusive of excavation, etc.

Material:	
Pipe, strainers, and manhole covers	$351.37
Cement and sand	310.75
Labor (laying pipe in concrete and filling trench)	457.78
	1,119.90

Cost of excavation.

Plant:	
Purchase	$7,946.04
Installation	1,753.54
Repairs and maintenance	1,198.69
Material used in excavation (coal, dynamite, expendibles, etc.)	3,626.98
Labor employed in excavation	24,859.34
	39,384.59
Earth and loose rock, 6,365 cubic yards at $0.81	5,155.65
Solid rock, 13,543 cubic yards at $2.60	34,228.94
Total, 19,908 cubic yards at $1.978	39,384.59

At the close of the fiscal year all excavation was completed, all drains were laid, and about 35 per cent of the fill had been made.

Emplacement No. 3 was completed up to the floor level, and No. 4 was completed up to the asphalt level except around the gun well, where the concrete was at the floor level.

Emplacement for one 12-inch rifle on disappearing carriage.—Excavation was begun on this emplacement in August, 1899, and continued throughout the year. The work consisted entirely of rock excavation and the laying of the drainage system. This system is to connect with that of the 10-inch battery, so that all the sewage from the 12-inch battery may be carried through the 10-inch battery drains. This will make it necessary to connect but one of the drainage systems with the ocean. It will make the drainage system of this emplacement cost more than the others, but it will prove the cheapest way by which to dispose of the sewage.

At the close of the fiscal year about 95 per cent of the excavation and about one-half of the entire drainage system was completed.

The following is the cost of rock excavation:

Plant:	
Purchase	$59.66
Repairs, maintenance	1,532.34
Material used in excavation (dynamite, coal, etc.)	1,872.28
Labor employed in excavation	10,067.36
Rock excavation, 5,764 cubic yards, at $2.348	13,531.64

Three emplacements for 15-pounder rapid-fire guns on balanced-pillar mounts: Work was begun on the roadway leading to this battery on September 14, 1899. The distance from the concrete plant to this battery is about 1,100 feet and the difference in elevation about 50 feet.

It was decided to lay a track connecting with those of the main lines, so that all material could be handled by power rather than by hand or teams. A much better roadway has been obtained, but at an increased cost; but as about 5,000 cubic yards of material was to be handled it seemed a decided advantage. The earth excavation was begun on September 16, 1899, and completed October 11, 1899; 290 cubic yards of earth were removed, 250 cubic yards of which were placed in the parapet as fill. The plant used for rock excavation was installed in October and November, and rock excavation was begun on November 11, 1899, and completed May 30, 1900. The plant used was all old plant that had been used on other works in the harbor, so there was but little cost for plant except for installation.

Two thousand cubic yards of rock were excavated and removed, 200 cubic yards being used as fill in the parapets, in the roadway in rear, and under the floors. The drainpipes were laid in April and May, and in June concrete work was begun on the walls and floors, about 95 cubic yards being placed. Nearly all the fixed forms have been constructed and some of the doors.

Cost of roadway:	
Material (ties, rails, etc.)	$526.18
Labor on roadway	660.61
	1,186.79

One-half of this material is charged as plant to rock excavation.

Cost of drains exclusive of excavation.

Pipe, strainers, and manhole covers	$70.26
Cement and sand	68.54
Labor, placing pipe and filling trench	148.02
Total	286.82

Cost of excavation.

Earth excavation, 290 cubic yards, at $0.864	$198.24

Rock excavation.

Plant:	
Purchase	$263.09
Installation	125.98
Repair and maintenance	378.41
Material used in excavation (coal, dynamite, etc.)	883.38
Labor employed in excavation	3,233.71
2,000 cubic yards, at $2.442	4,884.57

At the close of the fiscal year all excavation was completed, all drains were laid, and the concrete work was up to the floor level; the floors were constructed, and the false work for the rooms was in place. Much of the other false work had been constructed, and about 25 per cent of the fill had been made.

In giving costs everything is considered except the expense of the office in Portland, which up to date has been about 4 per cent.

Torpedo material.—The torpedo material has been overhauled and cleaned, under allotment of $700 made for that purpose from the appropriation for "Preservation and Repair of Fortifications."

Money statement.

Allotted July 24, 1899	$500.00
Allotted December 15, 1899	200.00
	700.00
June 30, 1900, amount expended during fiscal year	664.51
July 1, 1900, balance unexpended	35.49

Supplies for coast defenses.—The sum of $600 has been allotted from appropriation "Supplies for Coast Defenses," to be applied to filling requisitions by post commanders for material to be supplied by the Engineer Department.

Money statement.

Allotted June 7, 1900	$600.00
July 1, 1900, balance unexpended	600.00

3 B.

DEFENSES OF PORTSMOUTH, N. H.

Officers in charge, Maj. Solomon W. Roessler, Corps of Engineers, until September 30, 1899, and Maj. Walter L. Fisk, Corps of Engineers, since that date; assistants, Lieut. Thomas H. Jackson, Corps of Engineers, until September 30, 1899, and Lieut. (now Capt.) Charles Keller, Corps of Engineers, until November 15, 1899; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

Emplacements for two 8-inch guns on disappearing carriages.—This battery had been completed, under contract, at the beginning of the last fiscal year with the exception of the installation of electric-lighting plant, and turned over to the troops for use and care. A mining casemate, which was built in connection with the battery, had also been completed, at a total cost of $3,833.60. During the fiscal year a claim of the contractors for extra compensation for work under their contract was settled, in accordance with decision of the Board of Engineer Officers appointed by Special Orders, No. 45, Headquarters Corps of Engineers, August 23, 1899, to investigate and report upon said claim. The total cost of the battery to date has been $65,061.19.

Money statement.

July 1, 1899, balance unexpended	$7,213.79
June 30, 1900, amount expended during fiscal year	3,124.98
July 1, 1900, balance unexpended	4,088.81

Emplacements for three 10-inch guns on disappearing carriages.—During the previous fiscal year an allotment of $146,000 had been made for the construction of this battery, work thereon had been commenced, and at the beginning of the fiscal year a small quantity of earth had been excavated at the site of the battery, a substantial wooden wharf built, and temporary buildings for office, blacksmith shop, boiler sheds, and storehouse completed. The installation of a cable way for use in hauling material from excavation and for placing concrete had been nearly completed.

During the fiscal year the erection of all necessary plant and the earth and rock excavation have been completed, the concrete floors and parapet of one emplacement have been completed up to the height of the loading platform, and the floors of a second emplacement completed. The three carriages for the battery have been delivered and cared for.

The report of Mr. J. W. Walker, overseer, in immediate charge of the work, is hereto appended.

Money statement.

July 1, 1899, balance unexpended		$125, 611. 95
June 30, 1900, amount expended during fiscal year		57, 591. 67
July 1, 1900, balance unexpended		68, 020. 28
July 1, 1900, outstanding liabilities	$16, 778. 57	
July 1, 1900, amount covered by uncompleted contracts	13, 784. 96	
		30, 563. 53
July 1, 1900, balance available		37, 456. 75

Abstract of proposals for furnishing Portland cement and sand, opened March 23, 1900.

[13,000 barrels of cement and 5,000 cubic yards of sand.]

No.	Name and address of bidder.	Cement.			Sand.	
		Brand.	Price bid per barrel.	Total.	Price bid per cubic yard.	Total.
1	Bryant & Kent, Boston, Mass	Nazareth	$2.24	$29,120		
2	Boston Fire Brick Co. (Fiske & Co., managers), Boston, Mass.	Star	2.28	29,640		
3	Thomas W. Carter, Boston, Mass	Vulcanite	2.45	31,850		
4	W. G. Nash, Boston, Mass	Giant	2.20	28,600	$1.58	$7,900
a5	Waldo Brothers, Boston, Mass	Atlas	2.24	29,120	1.42	7,100
6	James H. Cahill, Boston, Mass				1.55	7,750

a Proposal accepted for cement; all sand bids rejected.

List of contracts in force during fiscal year ending June 30, 1900.

Contractor.	Articles.	Entered into.	Approved.	Commence.	Complete.
J. A. & A. W. Walker, Portsmouth, N. H.	Coal	May 26, 1899	June 22, 1899	At once	Dec. 31, 1899
W. L. Blake & Co., Portland, Me.	Oils, waste, and grease.	June 20, 1899	July 12, 1899	do	Do.
Berlin Mills Co., Portland, Me.	Pipe and fittings	June 29, 1899	Aug. 4, 1899	do	Do.
Waldo Bros., Boston, Mass.	"Atlas" Portland cement.	Apr. 28, 1900	May 14, 1900	do	Nov. 1, 1900

REPORT OF MR. J. W. WALKER, OVERSEER.

At the close of the last fiscal year but little had been done aside from the erection of necessary buildings and preparation of plant for future work. A small amount of earth had been removed from the face of the ledge at site of emplacement No. 1, and drilling had been commenced at the same emplacement with one steam drill during the last week of the fiscal year. The plant completed at that time consisted of a wharf 577 feet long, built by contract, and connected with the shore by a crib work 62 feet long, built by hired labor; a stiff-leg derrick on head of wharf, and hoisting engine to operate the same, a shed for the hoister on the wharf, an office building, blacksmith shop, storehouse, powder house, shed for boiler supplying steam for steam drills, water tank erected on a trestle and connected by a line of pipe with a steam pump which pumped water from a well sunk to a depth of 12 feet, and about 220 feet of trestling for railroad track, and about 1,100 feet of track. The boiler for the supply of steam for drills was assembled. Work was in progress on a cement shed of about 4,000 barrels capacity, and also on the excavation of a trench for depressed track for charge car. A Lidgerwood cableway of 280 feet span and 4 tons capacity was being erected by contract.

On July 10, upon completion of the cableway, work was commenced on the earth and rock excavation at site of battery. Two "F 24" Sergeant rock drills were used during the first weeks of the work; later a third drill of the same type was added. After being drilled and blasted, the broken rock was removed in skips by means of the cableway to the dump pile in rear of the emplacements. Material unfit for use in concrete work was hauled in dump cars to the railroad trestle and there used in making fill to the trestle. The earth excavated from the face of the ledge was handled in a similar manner by means of the cableway and deposited on the southerly side of the site of the battery, to be used later in making fill to embankment. The area over which excavation extended was 340 feet in length and of an average width of 60 feet. The earth excavation was material removed which covered the face of the ledge prior to drilling and blasting; it varied in depth from 1 to 3 feet. The rock excavation nowhere exceeded a depth of 10 feet, and three-fourths of the area was to a depth of less than 8 feet. The excavation of trenches for drain-pipes was begun in September and completed in November. A main drain of 6-inch vitrified pipe was laid from a manhole in rear of emplacement No. 3 to a point on the beach midway between high and low-water marks, a distance of 718 feet. Three manholes were built, one in rear of center of each emplacement. The 4-inch drains from gun centers to main drain have been laid; and the 3-inch pipe, laid with loose joints in broken stone, is laid with the exception of about 75 feet at emplacement No. 1. Work was commenced on the earth fill to embankment November 20 and was continued during the winter. The material used to make this fill was taken from the embankment of the old battery, loaded into dump cars and hauled by a cable operated from the tail tower of the cableway over a temporary track and trestle erected for that purpose to the top of the embankment and there dumped. About 4,075 cubic yards of earth were thus placed at the left flank and in front of emplacement No. 3, and extending for a short distance in front of emplacement No. 2. During the winter a small force was employed on the construction of wooden forms for concrete face work for one emplacement. On April 9 work was commenced on the rock foundation for battery and has been continued as the progress of concrete work required. About 600 cubic yards of rock were placed under the concrete floors and and weeper walls.

Since May 4 the work of placing concrete has been in progress. "Atlas" Portland concrete in proportions 1 to 2½ to 6, and "Atlas" Portland facing of cement and sand in proportions 1 to 2 are being used in the construction of the emplacements. No granolithic concrete has been used. The required proportions of material are placed in a bottom-dump charge car, carried by an elevator to the platform on top of the mixer frame and dumped into a cylindrical mixer. After receiving the necessary quantity of water the mixer is given sixteen turns, after which the concrete is dumped into tubs placed on flat cars. These cars are hauled by the locomotive to the nearest point on the railroad line to that where the concrete is to be placed; the tubs are taken by the cableway, carried to the desired place and there dumped. The concrete is spread in layers about 6 inches deep and thoroughly rammed with 23-pound rammers. The concrete facing is mixed and handled in the same way, excepting that for facing to walls, which is first placed on boards and shoveled from there to place. The average thickness of concrete facing is about three inches. All floors are first tamped and then finished with mason's floats. The average cost of 1 to 2½ to 6 concrete per yard in place has been $4.77; of concrete facing, $10.09. This includes cost of materials, cost of labor in handling materials, mixing, placing, and ramming. No charges for use of plant are included, nor cost of fuel, oil, and waste. No estimate of cost of forms per cubic yard of concrete in place has been made, for the reason that one set of forms is to be used for the three emplacements, and as yet the first emplacement is not completed. At the end of the year there were in place 2,491 cubic yards of cement, sand, and stone concrete, and 231 cubic yards of cement and sand facing. At emplacement No. 3 the concrete has all been placed to a level of one foot above the roof beams; at emplacement No. 2 the floors are completed and concrete laid around the gun circle to the bottom of the sump; at emplacement No. 1 a small amount of concrete has been placed over the drains and in the foundations for walls. A coating of "P. and B." paint No. 3 has been given to walls of air spaces and over roofs of rooms, as a watershed and to exclude dampness. The iron beams, anchor bolts, pipes for ventilation and for electric-light wires, gudgeons, and door frames have been placed at emplacement No. 3 as the work progressed. At emplacement No. 2 the anchor plates and bolts have been placed around the gun circle. The iron beams, pipes for hand rails, pipes for electric-light wires, ladders, cranes, brass hinges, and gudgeons have been delivered.

Three 10-inch disappearing carriages, L. F., model 1896, have been received, and have received necessary care to prevent rusting.

The plant now in use consists of the following:

1 cylindrical mixer, 6 feet 4 inches long, 5 feet diameter; run by a 25-horsepower engine.
1 No. 5 "Champion" crusher; run by a 25-horsepower engine.
1 elevator from crusher to stone bin, with screen and conveyor.
1 60-horsepower Lidgerwood boiler.
1 25-horsepower upright boiler.
(Both of the above boilers used to supply steam for rock-crushing and concrete-mixing plant.)
1 4-ton Lidgerwood cable way.
1 8-ton locomotive.
4 flat cars.
4 side-dump cars.
2 rock cars.
1 bottom-dump charge car.
1 three-drum hoister, erected on sand bin.
1 derrick, with double-drum hoister and boiler on wharf.
1 Worthington steam pump.
Assortment of picks, shovels, bars, rammers, shop tools, etc.

The mixer, crusher, and screen, with both 25-horsepower engines and the smaller boiler in use on concrete plant, were received from Maj. S. W. Roessler, Corps of Engineers, in charge of Portland district. They were formerly in use in Portland Harbor, and were loaned for the work at this place.

The buildings completed during the year were as follows: Cement shed, sand bin with inclined trestle leading to top, stone bin, locomotive shed and boiler house, coal pocket, mixer frame with elevator, sheds on cableway towers to protect the machinery, sheds over mixer and crusher engines, shed over sand bin hoisting engine. A building for use of cement tester was in course of construction at the close of the year and was about completed.

About 1,500 feet of track were laid, and the trench for depressed track completed and charge-car track laid. A trestle, with track, leading from rock pile to crusher platform was completed.

Cost of work.

Excavating 6,737 cubic yards rock at site of battery		$7,309.98
Average cost per cubic yard, $1.086.		
Excavating 1,898 cubic yards earth at site of battery		1,055.90
Average cost per cubic yard, $0.5563.		
Excavating 263 cubic yards rock for drainage system		1,257.47
Average cost per cubic yard, $4.7812.		
In the above items the cost of dynamite is not included, that used being sent from Portland, Me., where it had been stored for submarine-mining purposes. No cost of fuses is included, the cost not being known. There were expended in battery excavation 3,203 pounds of dynamite and 671 fuses; in excavation for drains, 605 pounds of dynamite and 375 fuses.		
Placing 4,075 cubic yards earth fill to embankment		2,802.30
Average cost per cubic yard, $0.6877.		
The cost for coal and oil is not included in this item.		
Rock excavation for drainage system, 263 cubic yards	$1,257.47	
Average cost per cubic yard, $4.7812.		
Laying pipes and building manholes	406.42	
False work for manholes to drains	36.87	
Unloading materials for drains	26.12	
Clearing and leveling trenches	193.05	
Materials, including pipe, cement, sand, and covers	561.15	
Total cost of drainage system		2,481.08

Labor on false work	$1,533.48	
Cost of materials, including transportation	1,580.95	
Total cost for false work		$3,114.43
Placing 2,491 cubic yards of 1 to 2½ to 6 concrete, at $4.77		11,882.07
Placing 231 cubic yards of 1 to 2 concrete facing, at $10.09		2,330.79
Placing 600 cubic yards of rock under floors and walls		637.04

Average cost per cubic yard, $1.0617.

Cost of plant.

No complete cost of plant can be given, the data for many of the more important items not being at hand.

The cost of the buildings completed during the year was as follows:

Cement shed:		
Labor	$378.17	
Materials	646.21	
		$1,024.38
Sand bin:		
Labor	512.78	
Materials	695.86	
		1,208.64
Sand-bin incline:		
Labor	100.78	
Materials	177.87	
		278.65
Stone-bin:		
Labor	289.67	
Materials	593.03	
		882.70
Coal pocket:		
Labor	33.24	
Materials	78.20	
		111.44
Locomotive and boiler shed:		
Labor	79.77	
Materials	38.37	
		118.14
Mixer frame:		
Labor	66.36	
Materials	126.35	
		192.71
Elevator to mixer:		
Labor	88.97	
Materials	49.30	
		138.27
Laboratory for cement testing:		
Labor	102.97	
Materials	267.97	
		370.94

This latter building, although not completed at the end of the year, was ready for use, and the remaining work will add but little to above amount.

The force employed has varied with the progress of the work. The average distribution of the crew during the present season is as follows:

Superintendence: 1 overseer, 1 timekeeper, and 1 rodman.

Breaking and crushing rock for concrete: 1 steam engineer, 2 stokers (one acting as oiler), and 16 laborers.

Mixing concrete: 2 steam engineers, 1 stoker, 1 cement mixer, and 8 laborers.

Placing and ramming concrete: 1 overseer, 3 steam engineers, 2 stokers, and 34 laborers (24 placing and 10 ramming).

False work: 1 master carpenter, 3 carpenters, and 8 helpers.

General work: 1 blacksmith, 1 helper, 1 cement tester, 2 laborers, 2 watchmen, and 1 boatman.

Progress of work at end of fiscal year.

The earth and rock excavation at site of battery was completed. The excavation for drainage system was completed and the main drain laid. The 4-inch pipe had all been laid and all the 3-inch pipe with the exception of about 75 feet. About one-third of the earth fill was in place. About three-eighths of the concrete had been placed. The plant and all buildings were practically completed. All ironwork for battery, about one-third the sand, and nearly one-half the cement had been delivered.

* * * * * * *

Cable tank.—An allotment of $2,800 was made November 28, 1898, for the construction of a cable tank, but nothing had yet been done toward its construction at the beginning of the fiscal year.

The tank was built during the fiscal year and is of concrete construction, 21 feet by 31 feet, covered with a frame shingle-roof building. A traveling crane for handling the cable has been installed and the building completed with the exception of placing the gutters and leaders.

Money statement.

July 1, 1899, balance unexpended	$2,784.88
June 30, 1900, amount expended during fiscal year	2,466.98
July 1, 1900, balance unexpended	317.90
July 1, 1900, outstanding liabilities	8.78
July 1, 1900, balance available	309.12

Fort McClary, Me.—The work done at this fort under allotments for preservation and repair consisted in putting the old engine house in condition to receive submarine-mining material and in removing some of the material there for storage. The material was also overhauled and cleaned.

Money statement.

July 1, 1899, balance unexpended	$665.56
June 30, 1900, amount expended during fiscal year	130.85
July 1, 1900, balance unexpended	534.71
July 1, 1900, outstanding liabilities	95.37
July 1, 1900, balance available	439.34

Fort Constitution, N. H.—The work done at this fort under allotments for preservation and repair consisted in removing the old blacksmith shop, in making certain alterations to improve the ventilation of the magazines, and in overhauling and caring for the searchlight plant.

Money statement.

July 1, 1899, balance unexpended	$879.85
June 30, 1900, amount expended during fiscal year	465.34
July 1, 1900, balance unexpended	414.51

3 C.

BOSTON HARBOR, MASSACHUSETTS.

Officer in charge, Col. Charles R. Suter, Corps of Engineers; assistants, Lieut. Charles S. Bromwell, Corps of Engineers, until April 5, 1900, and Lieut. Robert R. Raymond, Corps of Engineers.

SITE NO. 1.

Emplacements for five 10-inch guns on disappearing carriages.—Funds have been allotted as follows:

September 8, 1890	$50,000.00
August 16, 1895	35,138.16
August 16, 1895	7,000.00
December 12, 1891	106,194.05
August 16, 1895	9,000.00
August 16, 1895	2,000.00
August 2, 1898	3,800.00
May 15, 1899	3,000.00
May 31, 1899	2,500.00
Total	218,632.21
Withdrawn March 29, 1894	4,300.00

Of this amount $209,149.69 had been expended up to July 1, 1899, leaving a balance available of $5,182.52.

Emplacements Nos. 3 and 4 were begun and partially completed under the appropriation for "National Defense."

At the beginning of the fiscal year the emplacements were complete as regards their essential features, and the guns were mounted in Bastion B and Nos. 1 and 2, ravelin. To complete, there remained some details of the electric-lighting installation, a small amount of grading, and the construction of a road in rear of the ravelin battery. The armament for emplacements Nos. 3 and 4 was on hand ready for mounting.

During the fiscal year the base rings were set for the carriages of Nos. 3 and 4, and the carriages and guns were then mounted by the garrison. With the exception of the road in rear of the ravelin battery, the emplacements were completed in all respects, the completion of the road being prevented by the operation of the plant in use for the construction of two 12-inch emplacements, and a battery of three 15-pounder rapid-fire guns.

Money statement.

July 1, 1899, balance available	$5,182.52
Expended during fiscal year	4,999.81
July 1, 1900, balance available	182.71

Emplacements for two 12-inch guns on disappearing carriages.—These emplacements were authorized by Department letter dated June 4, 1898, and on October 19, 1898, there was submitted to the Chief of Engineers a plan which was afterward changed in some essential details and resubmitted December 28, 1898. It was approved by the Chief of Engineers January 3, 1899. The following allotments were made:

January 3, 1899, act of May 7, 1898	$123,000
March 3, 1900, act of March 3, 1897	5,772
May 4, 1900, act of July 7, 1898	7,488
June 27, 1900, act of July 7, 1898	1,027
June 27, 1900, act of May 25, 1900	1,473
Total	138,760

At the beginning of the fiscal year all the concrete in front of the old scarp wall had been completed to about 30 inches of the finished height, and about three-quarters of all the concrete in the old rooms and casemates was in place. The construction of forms for the traverses was in progress.

During the fiscal year the concrete was completed with the exception of the gun platforms, which were omitted to allow the mass of concrete upon which they stand to settle and come to a position of rest. During the latter half of the year no measurable settlement has occurred. The trolleys and chain lifts for ammunition delivery were installed, and the electric-lighting fixtures and lamps were placed in position. The earth cover of the parapet was allowed to settle under the action of the weather during the winter and spring, and its final grading has been nearly completed. At the end of the year there remained to complete the platforms and the mounting of the armament.

Money statement.

July 1, 1899, balance available	$76,028.39
Allotted since	15,760.00
	91,788.39
Expended during fiscal year	80,871.13
July 1, 1900, balance available	10,917.26

Battery for three 15-pounder rapid-fire guns.—These three emplacements were authorized by Department letter dated November 1, 1898. A plan and estimate was submitted June 19, 1899, and returned approved by the Chief of Engineers June 23, 1899.

The following allotments from the appropriation for "Gun and Mortar Batteries" have been made for the construction of this work:

June 23, 1899, act of July 7, 1898	$9,300
October 20, 1899, act of July 7, 1898	2,200
December 6, 1899, act of July 7, 1898	800
February 19, 1900, act of July 7, 1898	450
Total	12,750

At the beginning of the fiscal year the battery had been laid out on the ground ready for excavation, and arrangements had been made for procuring a portion of the necessary material.

During the year the battery was completed in all respects, the electric-lighting system was installed, the armament was mounted, and the work was turned over to the garrison.

This battery is provided with an overhead earth cover, the concrete roof being painted with P. & B. paint. The concrete was mixed in the proportions of 1 part cement (Atlas), 3 parts sand, and 8 parts broken stone, the cement being measured loose. The broken stone was used as it came from the crusher, no screening other than the removal of fine dust being allowed. The battery has no air spaces in its walls, but the outside of all walls is carefully drained. No water has penetrated the walls or roof. The electric conduits and the ceiling beams were placed in the concrete several inches from the surface, so as to leave as little metal exposed to the air as possible. Ordinary ventilators were provided, two being placed in each room as far apart as practicable.

There appears to be no condensation, and the battery has been dry at all times and in all weather.

Money statement.

July 1, 1899, balance available	$9,300.00
Allotted since	3,450.00
	12,750.00
Expended during fiscal year	12,738.38
July 1, 1900, balance available	11.62

Battery and fire commanders' stations.—A plan and estimate for a range-finder station was submitted to the Chief of Engineers July 5, 1899. This was returned approved July 8, 1899. The station was intended to be built for the control of the ravelin battery, but as this location was found to interfere with the future construction of a gun emplacement contemplated by the then approved project for the defense of Boston Harbor, the construction of the fire commander's station was authorized July 24, 1899.

On October 17, 1899, an estimate was submitted to the Chief of Engineers for the construction of two additional range-finder stations. The state of the appropriation not admitting of an allotment at that time the construction was deferred, to be finally authorized June 13, 1900.

The following allotments were made from the appropriation for "Gun and Mortar Batteries:"

July 8, 1899, act of July 7, 1898	$4,180
February 19, 1900, act of July 7, 1898	425
June 13, 1900, act of May 25, 1900	8,400
Total	13,005

At the beginning of the fiscal year nothing had been done.

During the year the fire commander's station was completed. The station consists of a brick tower, containing the observation room and having a roof of concrete and glass similar to the ordinary concrete and glass sidewalk construction. The pedestal for the instrument consists of a solid pier of concrete entirely independent of the tower, to prevent vibration.

Money statement.

Allotted during the fiscal year	$4,605.00
Expended during the fiscal year	4,515.43
July 1, 1900, balance available	89.57

During the year the plans for the two additional stations were completed and bids were invited for furnishing the required materials.

Money statement.

Allotted during the fiscal year	$8,400
July 1, 1900, balance available	8,400

Underground-conduit system.—The construction of this system of conduits was authorized by the Chief of Engineers October 9, 1899. The system consists essentially of four ducts set in concrete at a depth of at least 3 feet, with manholes at convenient intervals for drawing in the wires. A manhole is placed in the immediate vicinity of each emplacement and of each range-finding station, from which branches are conveniently run to each of these positions.

A plan and estimate for this work were submitted to the Chief of Engineers August 31, 1899, and were approved October 9, 1899.

Allotments for the work were made as follows from the appropriation for "Gun and Mortar Batteries:"

October 9, 1899, act of July 7, 1898	$7,000
June 14, 1900, act of May 25, 1900	2,250
Total	9,250

At the beginning of the fiscal year nothing had been done. During the year about 3,000 feet of conduit was completed.

Money statement.

Allotted during the fiscal year	$9,250.00
Expended during fiscal year	6,562.05
July 1, 1900, balance available	2,687.95

Central electric-lighting plant.—On October 19, 1899, a plan and estimate for this work were submitted to the Chief of Engineers. After correspondence with the Department, the plan was changed with regard to the size of the accumulator recommended in order to reduce the cost of the installation and the difficulty of caring for it when installed. The revised plan was approved November 15, 1899, and the sum of $10,000 was withdrawn from the allotment of $108,000 made July 22, 1897, from the appropriation for "Gun and Mortar Batteries," act of March 3, 1897, for mortar battery, Site No. 5, and reallotted to be applied to the installation of the electric-lighting plant.

At the beginning of the fiscal year nothing had been done.

During the year the work was completed in all respects. The installation consists of one General Electric 25-kilowatt generator, direct-connected to a 50-horsepower Armington & Simms horizontal engine, one General Electric set with vertical engine and 15-kilowatt 115-volt generator, one 50-horsepower vertical boiler, one 25-horsepower vertical boiler, 65 accumulator cells, 720 ampere-hours capacity, and the necessary controlling switchboard.

Money statement.

Allotted during the fiscal year	$10,000.00
Expended during the fiscal year	9,955.86
July 1, 1900, balance available	44.14

Moving guns and carriages.—On November 15, 1899, an allotment of $1,100 was made by the Chief of Engineers from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899, for moving two 10-inch guns and their carriages from the wharf to the proper emplacements.

At the beginning of the fiscal year nothing had been done.

During the year the guns and carriages were moved to emplacements Nos. 3 and 4 in the ravelin battery, where they were turned over to the garrison to be mounted.

Money statement.

Allotted during the fiscal year	$1,100.00
Expended during the fiscal year	1,100,00

SITE NO. 2.

Emplacements for five 10-inch guns on disappearing carriages.—Allotments for these emplacements were made as follows:

November 17, 1892, act of July 23, 1892	$58,000.00
August 16, 1895, act of March 2, 1895	16,174.75
August 16, 1995, act of March 2, 1895	5,500.00
June 30, 1896, act of June 6, 1896	100,000.00
November 7, 1896, act of June 6, 1896	52,200.00
June 23, 1897, act of March 3, 1897	45,000.00
Total	276,874.75

Of this amount $960.30 was withdrawn March 3, 1900.

At the beginning of the fiscal year the following work remained to be done: A small amount of grading and sodding in front of Nos. 1 and 2; providing locks for all doors (order for same had been placed); granolithic finish on stairs from terreplein to loading platform; changing temporary lighting installation to permanent one in Nos. 1, 2, and 3; railing for stairways above mentioned; and building walk in rear of No. 4 (will have to await the removal of light-house).

During the year the work was completed, except the walk in rear of No. 4, which can not be constructed until the light-house now occupying the ground is removed.

Money statement.

July 1, 1899, balance available	$16,535.81
Expended during the fiscal year	14,253.47
July 1, 1900, balance available	2,282.34

Battery commander's station.—An estimate and plan were submitted May 29, 1899, and were returned, approved by the Chief of Engineers June 7, 1899, making an allotment of $4,000 from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898. Additional allotments were made as follows from the same appropriation:

October 20, 1899	$1,200
February 19, 1900	185

making a total of $5,385.

At the beginning of the year arrangements had been made for obtaining materials, and the foundations of the walls were in place.

During the year the work was completed. The station resembles in its general features the stations described in the report for Site No. 1.

Money statement.

July 1, 1899, balance available	$4,000.00
Allotted since	1,385.00
	5,385.00
Expended during the fiscal year	5,338.13
July 1, 1900, balance available	46.87

Emplacements for two 15-pounder rapid-fire guns.—On July 15, 1899, a plan and estimate were forwarded to the Department. These were returned approved by the Chief of Engineers July 19, 1900.

Allotments for the work have been made as follows:

July 19, 1899, act of July 7, 1898	$9,000
October 20, 1899, same act	2,700
December 6, 1899, same act	1,500
Total	13,200

At the beginning of the fiscal year nothing had been done.

During the year the work was completed except sodding the slopes and providing ammunition lifts. No guns or carriages were received.

Money statement.

Allotted during the fiscal year	$13,200.00
Expended during the fiscal year	13,185.23
July 1, 1900, balance available	14.77

Underground-conduit system.—On September 12, 1899, a plan and estimate were submitted to the Department for a system of underground conduits for telephone and electric-light wires. These were returned approved by the Chief of Engineers September 15, 1899, and an allotment of $3,000 was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898.

At the beginning of the fiscal year nothing had been done.

During the year the work was completed. In its general features the conduit resembles that described in the report for Site No. 1.

Money statement.

Allotted during the fiscal year	$3,000.00
Expended during the fiscal year	3,000.00

Central electric-light plant.—An allotment of $6,300 was made by the Chief of Engineers on November 15, 1899, from the appropriation for "Gun and Mortar Batteries," by transfer from another allotment for the installation of a central electric-lighting plant.

At the beginning of the year nothing had been done.

During the year the work was completed. The plant consists of a 25-kilowatt, 115-volt, General Electric generator direct-connected to a 50-horsepower Armington & Simms horizontal engine, one 50-horsepower vertical tubular boiler, 65 accumulator cells, 400 ampere-hours capacity and the necessary switch boards. The accumulator is charged in two sections and discharged in series, the voltage on discharge being controlled by a system of end cells.

Money statement.

Allotted during the fiscal year	$6,300.00
Expended during the fiscal year	6,299.59
July 1, 1900, balance available	.41

SITE NO. 3.

Emplacements for three 12-inch guns on disappearing carriages.—Construction was begun and the battery was essentially completed with funds allotted from the appropriation for "National Defense." The following allotments have been made from the appropriation for "Gun and Mortar Batteries:"

June 9, 1899, act of March 3, 1899	$9,000.00
August 19, 1899, act of July 7, 1898	6,000.00
June 1, 1900, act of July 7, 1898	5,800.00
December 14, 1899, act of March 3, 1899	2,500.00
March 30, 1900, act of June 6, 1896	19.50
March 30, 1900, act of May 7, 1898	376.68
March 30, 1900, act of March 3, 1899	103.82
Total	23,800.00

The allotments of June 9, 1899, and June 1, 1900, amounting to $14,800, were to be applied to the completion of the battery; that of August 19, 1899, $6,000, was for the repair of walls damaged by frost, but its application to the completion was authorized, and those of December 14, 1899, and March 30, 1900, amounting to $3,000, were to be applied to mounting the armament.

At the beginning of the fiscal year the battery had been completed with the exception of the following details: Completion of grading and sodding, installation of speaking tubes, electric-light wiring, guard-room window shutters, water supply, road in rear of battery, painting ironwork, whitewashing, etc. The three guns and their carriages were on hand ready for mounting.

During the year the grading and sodding were completed, the concrete plant and derricks were removed for use elsewhere, and the guns were mounted and placed in position for service.

It will be necessary to postpone the construction of the road until the water supply and possibly the electric light and telephone wire conduits have been installed, to prevent doing the work twice.

Money statement.

July 1, 1899, balance available	$9,000.00
Allotted since	14,800.00
	23,800.00
Expended during the fiscal year	18,075.75
July 1, 1900, balance available	5,724.25

Fire commander's and battery commander's stations.—The construction of these stations was authorized by the Chief of Engineers September 25, 1899, and an allotment of $6,400 was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898. On account of the near approach of cold weather, authority was granted for the postponement of the work of construction until danger from frost should be past.

At the beginning of the fiscal year nothing had been done.

During the year working drawings were made, materials were purchased, foundations were laid, and the masonry was begun. These stations resemble in their general features the station described in the report for Site No. 1.

Money statement.

Allotted during the fiscal year	$6,400.00
Expended during the fiscal year	362.34
July 1, 1900, balance available	6,037.66

SITE NO. 4.

Mortar battery.—This battery provides emplacements for sixteen 12-inch rifled mortars.

It is a part of the outer line of defense of Boston Harbor, Massachusetts.

The detailed plans of this battery were approved by the Chief of Engineers April 14, 1891.

On June 30, 1897, this battery had been completed and had been turned over to the commanding officer, for use and care of the troops, on July 25, 1896, in accordance with provisions of paragraph 1486, Army Regulations, July 25, 1896, under authority of the Acting Secretary of War, dated June 29, 1896.

It is now in charge of an artillery garrison.

In October, 1897, the balance of funds on hand was transferred to the mortar battery at Site No. 5, and the work dropped by authority of the Department.

On June 14, 1898, $500 was allotted from the appropriation for "Gun and Mortar Batteries" for the purpose of easing the slopes around the mortar carriages. On July 21, 1898, a further allotment of $400 was made from the same appropriation.

On August 27, 1898, an allotment of $1,500 was made from the appropriation for "Gun and Mortar Batteries" for rewiring and repairing the electric-lighting plant, and on September 30, 1898, a further allotment of $4,000 was made from the same appropriation for the construction of a power house and the installation of a new generating plant.

On March 1, 1900, the sum of $375 was allotted by transfer from the allotment for a mortar battery at Site No. 5 for hanging magazine doors.

At the beginning of the fiscal year all work had been completed except hanging the doors, and the battery was in the hands of an artillery garrison. During the year the doors were hung.

Money statement.

July 1, 1899, balance available	$729.70
Allotted since	375.00
	1,104.70
Expended during the fiscal year	1,104.70

SITE NO. 5.

Mortar battery.—This site embraces about 33 acres at the northern end of an island. The Commonwealth of Massachusetts ceded jurisdiction over the same to the National Government by act approved April 6, 1897.

Plans prepared by The Board of Engineers, dated August 1, 1889, provided for a battery of sixteen 12-inch mortars at this site.

By Department letter of April 6, 1897, plans and estimates for the construction of emplacements for eight 12-inch mortars were called for. These were prepared and submitted on July 17, 1897, and an allotment of $108,000 was made July 22, 1897, from the appropriation for "Gun and Mortar Batteries," act of March 3, 1897.

On May 14, 1898, bids were opened. The award was made to Yates

& Triest, of New York, the lowest bidder, and contract was entered into on June 9, 1898. Excavation was begun on June 15, 1898.

The contractors having failed to complete the work before November 1, 1898, as required by the contract, an extension of time was granted at their request October 26, 1898, requiring the work to be completed by June 1, 1899. The contract expired by limitation on June 1, 1899.

The following funds were withdrawn for use elsewhere:

November 9, 1899	$3.10
November 15, 1899	16,300.00
March 1, 1900	375.00
March 3, 1900	5,772.00
March 3, 1900	1,000.00
Total	23,450.10

At the beginning of the fiscal year the battery was complete except finishing the grading and sodding, completing the road to the wharf, and setting base rings and paving mortar pits.

During the year the road was completed, the embankments were graded and sodded, and the contractor removed his plant. The armament was then mounted by hired labor, and the paving of the pits was nearly completed. Considerable changes were made in the earth embankments, which contained sufficient clay to cause them to slide into the pits when wet. Practically no sliding has occurred since. To complete the battery there remains only the installation of the electric-lighting plant. Some materials are on hand, but the work has been postponed until the electricians complete their work at other points.

Money statement.

July 1, 1899, balance available	$64,954.63
Withdrawn since	23,450.10
	41,504.53
Expended during the fiscal year	39,990.53
July 1, 1900, balance available	1,514.00

Emplacements for two 5-inch rapid-fire guns.—On November 28, 1899, an allotment of $20,000 was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, for the construction of emplacements for two wire-wound rapid-fire guns mounted on pedestal mounts.

At the beginning of the fiscal year nothing had been done.

During the year the concrete work was practically completed and the earth for the parapet and overhead cover was partially in position, requiring only to be moved a short distance and to be graded. The battery was ready to receive its armament. No guns or carriages were received.

Money statement.

Allotted during the fiscal year	$20,000.00
Expended during the fiscal year	12,988.42
July 1, 1900, balance available	7,011.58

SITE NO. 6.

Emplacements for two 12-inch guns on nondisappearing carriages.—This battery consists of two emplacements for 12-inch rifles mounted in barbette, and its construction was begun with funds allotted from the appropriation for "National Defense."

The following allotments have been made from the appropriation for "Gun and Mortar Batteries:"

July 6, 1899, act of March 3, 1899	$5,000.00
March 3, 1900, by transfers	1,960.30
Total	6,960.30

At the beginning of the fiscal year the battery was complete in all but a few details. During the year the following work was completed: Grading and sodding slopes in rear of battery, installation of electric-lighting plant, permanent water supply, painting ironwork, and setting base rings. A wash of alum, lye, and cement was applied to the exterior surfaces of the concrete to render them impervious to water. This only partially improved the condition of the battery as regards dryness, for water still penetrates the joints between paving blocks of concrete.

Money statement.

Allotted during the fiscal year	$6.960.30
Expended during the fiscal year	5,834.36
July 1, 1900, balance available	1,125.94

Mounting 12-inch rifles and carriages.—On December 14, 1899, an allotment of $1,200 was made by the Chief of Engineers for this work, from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899.

At the beginning of the fiscal year nothing had been done.

During the year the two carriages were mounted ready to receive the guns. No guns were received and none are on hand.

Money statement.

Allotted during the fiscal year	$1,200.00
Expended during the fiscal year	378.57
July 1, 1900, balance available	821.43

Emplacements for 5-inch rapid-fire guns.—On September 24, 1898, instructions were received for the preparation of plans for the construction of emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts. The plans and an estimate of cost were submitted March 23, 1899, and were approved March 30, 1899.

The following allotments were made from the appropriation for "Gun and mortar batteries:"

March 30, 1899, act of July 7, 1898	$11,500
March 3, 1900, act of July 7, 1898	2,550
Total	14,050

At the beginning of the fiscal year the excavation had been completed, the concrete had been placed up to the ceiling level, and the drains, speaking tubes, electric conduits, and earth slopes were nearly completed. During the year the concrete and earthwork were completed, the ammunition lifts were installed, and the two carriages were mounted in readiness to receive the guns. No guns were on hand and none were received. There remains to complete the battery the setting up of the hand rails. These had been ordered but had not been delivered at the end of the year.

Money statement.

July 1, 1899, balance available	$9,970.77
Allotted since	2,550.00
	12,520.77
Expended during the fiscal year	12,143.62
July 1, 1900, balance available	377.15

SITE NO. 7.

Emplacements for three 6-inch rapid-fire guns.—On January 5, 1899, the Department requested the preparation of plans and estimates for the construction of emplacements for three 6-inch rifles on disappearing carriages at Site No. 3, in accordance with the then approved project for the defense of Boston Harbor, and a recommendation of a site for these guns.

On May 4, 1899, a letter was forwarded to the Chief of Engineers stating that no advantageous site could be found at Site No. 3, and recommending this site, at which it was possible to construct more economically a more efficient battery. This change of site was approved May 26, 1899.

Detailed plans and an estimate of cost, including the cost of a wharf, railroad, and other necessary plant, were submitted May 16, 1899, and were approved May 29, 1899, on which date an allotment of $65,000 was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898.

At the beginning of the fiscal year, the preparation of plans for the wharf and construction plant was in progress. During the year the wharf was constructed, the railroad was laid, material was received, and about one-half of the concrete was placed. When work was begun no facilities existed for quartering the men or receiving and storing materials. Several old and dilapidated engineer buildings were temporarily used. One of these was totally destroyed by a storm. A large and comfortable barrack, with water supply, was built. A storage cistern and well, with a windmill, and a steam pump and water tower for both fresh and salt water were constructed or installed. Three derricks and hoisting engines were also installed, and the necessary storehouses and blacksmith shop were built and equipped. The excavation for the battery, the drainage system, and about one-half the concrete work were completed.

Two disappearing carriages for 6-inch breech-loading rifles were received. No other armament was received or on hand.

Money statement.

July 1, 1899, balance available	$65,000.00
Expended during the fiscal year	47,314.08
July 1, 1900, balance available	17,685.92

Emplacements for two 15-pounder rapid-fire guns.—On June 20, 1900, the Chief of Engineers authorized the construction of these emplacements, and allotted the sum of $12,000 from the appropriation for "Gun and Mortar Batteries," act of May 25, 1900.

At the beginning of the fiscal year nothing had been done. During the year the plans of the battery were prepared and a survey of the site was made. Preparations were made for obtaining materials and for installing the working plant. The work at the site was not begun.

Money statement.

Allotted during the fiscal year	$12,000.00
July 1, 1900, balance available	12,000.00

TORPEDOES FOR HARBOR DEFENSE.

On October 8, 1898, an allotment of $2,000 was made from the appropriation for "Torpedoes for Harbor Defense," act of May 7, 1898, for the construction of a mining casemate. This casemate consists of a brick structure affording rooms for engine and dynamo, storage battery, oil supply, and the operating devices for the mines.

During the fiscal year the casemate was completed and will be ready for service as soon as it is connected with the cable gallery.

Money statement.

July 1, 1899, balance available	$2,000.00
Withdrawn	600.00
	1,400.00
Expended during the fiscal year	1,300.51
July 1, 1900, balance available	99.49

On January 13, 1897, an allotment of $4,300 was made from the appropriation for "Torpedoes for Harbor Defense," act of June 6, 1896, for the construction of a cable storage tank. At the beginning of the fiscal year the tank was completed, except for a suitable hoisting device for handling the cable drums. Providing such a hoisting device was postponed in view of the apparent necessity of increasing the size of the tank.

Money statement.

July 1, 1899, balance available	$1,972.14
Deposited to the credit of the United States Treasurer	1,972.14

The following allotments were made from the appropriation for "Torpedoes for Harbor Defense," for the construction of a second mining casemate:

October 8, 1898, act of May 7, 1898	$2,700
December 18, 1899, act of June 6, 1896	250
December 18, 1899, transferred	600
Total	3,550

At the beginning of the fiscal year the casemate had been constructed up to the ceiling level. During the year the casemate was completed and the generating machinery was installed.

Money statement.

July 1, 1899, balance available	$2,700.00
Allotted since	850.00
	3,550.00
Expended during the fiscal year	3,532.03
July 1, 1900, balance available	17.97

On July 28, 1897, an allotment of $1,035 was made from the appropriation for "Torpedoes for Harbor Defense," act of March 3, 1897, for the removal and storage of torpedo material.

During the fiscal year the work was completed and the material was inspected and the quantities verified.

Money statement.

July 1, 1899, balance available	$14.61
Expended during the fiscal year	14.61

On March 13, 1899, an allotment of $2,000 was made from the appropriation for "Torpedoes for Harbor Defense," act of May 7, 1898, for the storage of torpedo material. During the fiscal year the work was entirely completed.

Money statement.

July 1, 1899, balance available	$242.04
Expended during the fiscal year	242.04

PRESERVATION AND REPAIR OF FORTIFICATIONS.

The following allotments have been made from the appropriation for "Preservation and Repair of Fortifications," for work at the site of the emplacements for five 10-inch and two 12-inch guns:

June 9, 1899, act of May 7, 1898	$800
June 9, 1900, act of May 25, 1900	500
February 13, 1900, act of March 3, 1899	175
Total	1,475

During the fiscal year general care was taken of the batteries and their power plant, repairs were made to the lifts and concrete steps of the ravelin battery, and the searchlight outfits were overhauled and cleaned.

Money statement.

July 1, 1899, balance available	$800.00
Allotted since	675.00
	1,475.00
Expended during the fiscal year	653.97
July 1, 1900, balance available	821.03

An allotment of $175 was made June 9, 1899, from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, for repairing the bridge leading to the keep, and the roof and windows of the keep, of one of the works of older type.

At the beginning of the fiscal year nothing had been done. During the year the repairs were made.

Money statement.

July 1, 1899, balance available	$175.00
Expended during the fiscal year	120.62
July 1, 1900, balance available	54.38

On July 19, 1898, an allotment of $2,200 was made from the appropriation for "Preservation and Repair of Fortifications," for repairs to the wharf at another work of older type. During the year plans and estimate for this work were prepared and proposals were invited, but all bids were rejected. An effort was made to secure more favorable prices, but as this failed the work was postponed. Later in the year the Treasury Department secured authority to occupy a portion of the site of this work, including the site of the wharf, for a depot for the Light-House Establishment, and as such use of the site would necessitate the construction of a new and larger wharf, no further steps for the repair of the old wharf were taken.

Money statement.

July 1, 1899, balance available	$2,200.00
Expended during the fiscal year	26.80
July 1, 1900, balance available	2,173.20

On December 24, 1897, an allotment was made from the appropriation for "Preservation and Repair of Fortifications," under which a portion of the mine cases on hand for the defense of Boston Harbor were repainted.

The following allotments were made for the care of the torpedo material for the defense of Boston:

January 15, 1900, act of March 3, 1899	$1,500
June 9, 1900, act of May 25, 1900	100
Total	1,600

During the fiscal year the torpedo material was counted, cleaned, and carefully stored.

Money statement.

July 1, 1899, balance available	$4.45
Allotted since	1,600.00
	1,604.45
Expended during the fiscal year	1,427.08
July 1, 1900, balance available	177.37

The following allotments have been made for miscellaneous repairs at Site No. 2 from the appropriation for "Preservation and Repair of Fortifications:"

June 9, 1899, act of May 7, 1898	$500
June 9, 1900, act of May 25, 1900	300
Total	800

Under these allotments the power plant was kept in order during the fiscal year, and the interior of the battery was whitewashed and the ironwork painted.

Money statement.

July 1, 1899, balance available	$500.00
Allotted since	300.00
	800.00
Expended during the fiscal year	410.56
July 1, 1900, balance available	389.44

The following allotments were made for the prevention of dampness in the magazines at Site No. 2:

August 15, 1899, act of March 3, 1899	$4,000
December 6, 1899, act of March 3, 1899	250
Total	4,250

Under these allotments, during the fiscal year the old porous concrete was removed from the roof of the magazines to a sufficient depth for repaving, and a new and water proof paving was laid and a drain was constructed along the front edge of the concrete of the parapet.

Money statement.

Allotted during the fiscal year	$4,250.00
Expended during the fiscal year	4,183.10
	66.90
Deposited with United States Treasurer	66.90

On June 8, 1900, $210 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for the demolition and removal of two old engineer buildings which were occupying ground required for other purposes. During the fiscal year the buildings were removed.

Money statement.

Allotted during the fiscal year	$210.00
July 1, 1900, balance available	210.00

An allotment of $800 was made June 9, 1900, from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, for pay of watchmen for six months and for miscellaneous repairs at Site No. 3.

During the fiscal year the guns and carriages were kept in order and general care was taken of the reservation and emplacements.

Money statement.

Allotted during the fiscal year	$800.00
July 1, 1900, balance available	800.00

The following allotments were made from the appropriation for "Preservation and Repair of Fortifications," for work at Site No. 4:

June 9, 1899, act of May 7, 1898	$415
February 19, 1900, act of March 3, 1899	180
June 9, 1900, act of May 25, 1900	150
Total	745

The first-named allotment was made before the separation of the gun battery at this locality from the mortar battery, and therefore repairs were made under this allotment at the gun battery, now Site No. 3, where general care was taken of the emplacements, and the guns and carriages were cleaned and kept in order. No work was done under the second allotment.

Money statement.

July 1, 1899, balance available	$415.00
Allotted since	330.00
	745.00
Expended during the fiscal year	543.23
July 1, 1900, balance available	201.77

Allotments have been made from the appropriation for "Preservation and Repair of Fortifications" as follows, for work at Site No. 5:

June 9, 1899, act of May 7, 1898	$365
June 9, 1900, act of May 25, 1900	1,000
Total	1,365

During the year general care was taken of the reservation and batteries. A watchman was kept on the post when work was not in progress.

Money statement.

July 1, 1899, balance available	$365.00
Allotted since	1,000.00
	1,365.00
Expended during the fiscal year	347.52
July 1, 1900, balance available	1,017.48

For the general care and preservation of the works at Site No. 6 allotments have been made as follows:

March 1, 1900, act of March 3, 1899	$360
June 9, 1899, act of May 7, 1898	365
June 9, 1900, act of May 25, 1900	1,500
Total	2,225

During the fiscal year general care was taken of the reservation and of the batteries. A watchman was kept on the post when work was not in progress. The storage battery was thoroughly overhauled and cleaned, the connections between cells were lead-burned, and ten extra cells were added to the battery to increase its voltage.

Money statement.

July 1, 1899, balance available	$365.00
Allotted since	1,860.00
	2,225.00
Expended during the fiscal year	714.75
July 1, 1900, balance available	1,510.25

On June 9, 1900, an allotment was made from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, for necessary miscellaneous repairs at Site No. 7.

No work was done during the fiscal year.

Money statement.

Allotted during the fiscal year	$250.00
July 1, 1900, balance available	250.00

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

On August 17, 1896, a report was requested by the Chief of Engineers upon the areas which should be acquired for sites for works of defense for Boston Harbor, to be located on land not then owned by the United States, as indicated in the approved project of The Board of Engineers dated August 1, 1889; the names of the owners; the area owned by each; the improvements thereon, if any; the lowest price at which each owner would probably sell; whether such prices were considered reasonable, and whether the sites should be purchased by agreement with the owners or should be acquired by condemnation.

Approximate estimates were telegraphed to the Department September 19, 1896.

The land required at one of these sites had been purchased at the beginning of the fiscal year. An allotment of $33,130 was made January 12, 1897, from the appropriation for "Sites for Fortifications and Seacoast Defenses," act of June 6, 1896. A balance of $1,999.46 was available at the end of the fiscal year and applicable to the purchase of a site at another locality.

During the fiscal year negotiations were carried on for the purchase of four lots to complete the acquisition of the required tract at a second site. Two of these lots were purchased and paid for. The following allotments have been made from the appropriation for "Sites for Fortifications and Seacoast Defenses":

June 12, 1897, act of June 6, 1896	$185,160.79
June 12, 1897, act of March 3, 1897	64,839.21
June 17, 1897, act of March 3, 1897	1,248.85
Total	251,248.85

Money statement.

July 1, 1899, balance available	$18,543.68
Expended during the fiscal year	11,344.52
July 1, 1900, balance available	7,199.16
Balance from another locality applicable to this site	1,999.46
July 1, 1900, total balance available	9,198.62

Allotments for the examination and appraisal of the land required at a third site were made as follows:

September 8, 1898, act of May 7, 1898	$100
September 9, 1899, act of May 7, 1898	1,400
Total	1,500

During the year the land was appraised by an expert real-estate agent.

Money statement.

July 1, 1899, balance available	$98.04
Allotted since	1,400.00
	1,498.04
Expended during the fiscal year	1,426.61
July 1, 1900, balance available	71.43

An allotment was made September 13, 1899, from the appropriation for "Sites for Fortifications and Seacoast Defenses," for the purchase of about 48 acres of land at the same site:

Act of May 7, 1898	$142,517.06
Act of March 3, 1899	142,982.94
Total	285,500.00

During the fiscal year active negotiations were carried on for the acquisition of the required land. Seventy-three parcels were acquired from 39 owners, at a cost of $178,079.37, against an appraised value of $196,291.37, aggregating 1,584,033.1 square feet out of a total of 1,970,044 square feet. All deeds received were referred to the United States district attorney for examination.

No expenditures were made during the fiscal year. Under the authority of the Secretary of War, Mr. George A. Dary was employed to make the abstract of title required in the acquisition of the required land.

An allotment of $1,000 was made September 22, 1899, from the appropriation for "Sites for Fortifications and Seacoast Defenses," act of March 3, 1899, for a survey of this site. During the year the survey was completed.

Money statement.

Allotted during the fiscal year	$1,000.00
Expended during the fiscal year	254.70
July 1, 1900, balance available	745.30

SUPPLIES FOR COAST DEFENSES.

On June 9, 1900, an allotment of $1,000 was made from the appropriation for "Supplies for Coast Defenses," act of May 25, 1900, for the purchase of electrical supplies upon requisition of post commanders, under the provisions of General Orders, No. 66, Adjutant General's Office, 1900.

No requisitions were received during the fiscal year, and no expenditures were made.

3 D.

DEFENSES OF SOUTHEAST COAST OF MASSACHUSETTS AND RHODE ISLAND AT NEW BEDFORD, MASSACHUSETTS, AND NEWPORT, RHODE ISLAND.

Officer in charge, Maj. Daniel W. Lockwood, Corps of Engineers; assistant, Lieut. Robert P. Johnston, Corps of Engineers; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

NEW BEDFORD, MASSACHUSETTS.

Emplacements for two 8-inch guns on disappearing carriages.—Under date of June 26, 1899, an allotment of $800 from the act of March 3, 1899, for "Gun and Mortar Batteries" was made for the completion of these two emplacements, which had been in course of construction since April, 1898, with "National Defense" funds. For details as to work already done, see page 724, Part I, Annual Report of the Chief of Engineers for 1899.

At the beginning of the year these emplacements were ready to be transferred to troops for use and care, with the exception of electric lighting.

During the year, early in July, quite a severe rainstorm caused a portion of the sod on the slopes to slip a little, and this damage was repaired during the same month. All ordnance and ordnance stores on hand July 31, 1899, together with the two emplacements, were transferred on that date to the ordnance sergeant stationed at this post. No further work was done during the year on these emplacements save that of maintenance. Some minor repairs will be made and dampness in the rooms corrected with funds already allotted during the past year from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899.

Money statement.

July 1, 1899, balance unexpended	$800.00
June 30, 1900, amount expended during the year	593.14
July 1, 1900, balance unexpended and available	206.86

Emplacements for four 5-inch rapid-fire guns.—Under the provisions of the deficiency act of Congress approved July 7, 1898, it is proposed to construct emplacements on which to mount four 5-inch rapid-fire guns of the navy pattern, Brown segmental wire type. An allotment of $13,300 from said act for the construction of two of these emplacements was made under date of August 30, 1898, and under date of September 6, 1899, an additional allotment of $4,200 was made.

During the year, under date of July 13, 1899, the Chief of Engineers, United States Army, directed that sites for the above emplacements be selected, and that plans and estimates for their construction be submitted. Under date of August 25, 1899, said plans and estimates were submitted for two of the emplacements, and approved in September. By Department indorsement of September 30 authority was received to defer construction work until next spring, owing to difficulty of obtaining cement. However, the necessary excavation was made, and a few cubic yards of concrete foundation placed for magazine and bomb proofs, and some 500 feet of drain pipe laid.

Active work was resumed in May, and by the close of the year nearly all of the forming timber work had been completed and about 380 cubic yards of concrete placed in the walls and footings, and a small portion of the I-beams, electric-light wire, pipes, and speaking tubes had been placed.

This work was in the immediate charge of Assistant Engineer William M. Hall throughout. For details see his report attached hereto.

Money statement.

July 1, 1899, balance unexpended	$13,300.00
Amount allotted since	4,200.00
	17,500.00
June 30, 1900, amount expended during the year	7,438.37
July 1, 1900, balance unexpended	10,061.63
July 1, 1900, outstanding liabilities	6,852.74
July 1, 1900, balance available	3,208.89

REPORT OF MR. WILLIAM M. HALL, ASSISTANT ENGINEER.

I have the honor to submit the following report upon the construction of an emplacement for two 5-inch rapid-fire guns at New Bedford, Mass., during the fiscal year ending June 30, 1900:

The construction of this structure was authorized on September 15, 1899. In anticipation of this authority, bills of material and circular advertisements had been prepared for the purchase of cement, stone, gravel, sand, etc., required for its construction. These advertisements were mailed to probable bidders on the date above, September 15. The advertisement for cement was sent to nine of the principal manufacturers and dealers in Portland cement. When bids were opened, on September 25, it was found that we could get no dealer or manufacturer to undertake the delivery of the Portland cement before November 1, 1899. This was deemed too late a date to admit of its use in concrete construction before freezing weather. It was therefore decided to defer the erection of the structure, except the foundation, till the season of 1900.

During October a hoist engine and two derricks were moved to site of the emplacement and erected for use in building the concrete work, the necessary tramway track was laid from concrete mixer to emplacement site, and work of construction on emplacement was done as follows: 210 cubic yards of excavation for foundation, 110 cubic yards of concrete for foundation, 1,105 square feet of magazine and bombproof, 77 feet 6-inch vitrified pipe, 156 feet of 4-inch, and 12 feet of 3-inch pipe for drainage. In November, 300 linear feet of 1½-inch tarred water-supply pipe was laid.

During the winter the I-beams for ceiling over magazines and bombproofs were received; also the anchor rings and rods for the gun carriages, and some other smaller material.

During March, 1900, advertisements asking proposals for furnishing cement, sand, gravel, crushed stone, lumber, and other materials and supplies were again issued to probable bidders. Bids were received and contracts awarded. Contract for cement was awarded to the agents for Giant Portland cement. The cement was delayed in transit to the work and did not arrive here till May 21—nearly one month later than expected. On May 11 we commenced framing concrete form timbers, and on June 16 commenced placing concrete for that part of structure above foundation.

The placing of concrete is now regularly progressing with one (day) force of about 45 men. To this date, inclusive, about 490 cubic yards have been placed.

The composition of this concrete is of the following mixtures: The large blocks immediately underneath the gun platform and below the level of anchor plates is composed of 1 part of Rosendale cement, 2 parts of sand, 2 parts of gravel, 3 parts crushed stone; all the thin walls or parts of walls and platforms within one foot of finished exposed surfaces are composed of 1 part Portland cement, 2 parts of sand, 2 parts of gravel, 3 parts of crushed stone; all other large masses (excepting the two named above) are composed of 1 part of Portland cement, 3 of sand, 3 of gravel, 4½ of crushed stone. All exposed faces and top surfaces are finished with Portland cement mortar mixed 1 part cement, 2 parts sand. In all the large masses of concrete large granite stones and bowlders, picked up from grounds here, are being embedded.

The concrete mixer and other plant used in doing this work is the same described in my annual report for fortification construction at this place during 1898 and 1899.

The cement being used is Hoffman Rosendale natural and Giant American Portland. Both kinds were systematically tested for weight, fineness, tensile strength, time of setting, and soundness.

The gravel came from Long Island Sound, near Willets Point, and the crushed stone from Clinton Point, on the Hudson River. They are of the same quality and described in my annual report of 1898.

The sand is from Tripps bank in Fairhaven about 1 mile northerly from the New Bedford-Fairhaven Bridge. Samples of the sand were tested during delivery. It is fairly sharp and of the following texture:

	Per cent.
Voids, of volume	30
Held by a No. 20 sieve	54
Passed by No. 20 and held by No. 30	19
Passed by No. 30 sieve	25
Loam	2

In building the emplacement the concrete is, so far as possible, being placed in layers and not in sections. It is mixed rather wet, but not so as to quake. All other details of the work are conducted about as described for similar work in annual report of 1898.

	Labor.	Materials.	Total.
Clearing site and staking out work	$19.40		$19.40
Moving and erecting derricks, laying track, etc	315.49		315.49
Tools and repairs to plant	117.61	$455.92	573.53
Water supply	111.80	166.75	278.55
Excavation for foundation	204.20	39.00	243.20
Materials, framing and erecting concrete forming	649.85	893.01	1,542.86
Materials for concrete	522.77	6,979.59	7,502.36
Testing cement	155.91		155.91
Concrete construction	1,316.91	93.26	1,410.17
Lighting and speaking-tube systems	15.00	66.13	81.13
Drainage system in place	15.60	164.46	180.06
I-beams for ceilings	25.40	341.82	367.22
Asphalt waterproofing		103.50	103.50
Anchor bolts and plates for gun carriages		157.18	157.18
Embankments	28.40	50.05	78.45
Watching plant	85.00		85.00
Miscellaneous	1,112.50	84.60	1,197.10
Total	4,695.84	7,595.27	14,291.11

The progress of this emplacement may be more clearly indicated by the following chronological table:

Construction of emplacement authorized September 15, 1899.
Advertisements for material issued September 15, 1899.
Excavation for foundation commenced October 11, 1899.
Placing concrete for foundation commenced October 15, 1899.
Three hundred linear feet of water-supply pipe laid in November, 1899.
Work closed for winter in November, 1899.
Readvertised for materials in March, 1900.
Received stone, gravel, sand, etc., in April, 1900.
Received Portland cement May 21, 1900.
Commenced erecting concrete forming May 11, 1900.
Resumed placing concrete June 16, 1900.
The placing of concrete is now in progress.

Mining casemate.—Under the provisions of the act of May 7, 1898, it is proposed to construct a mining casemate. Plans and estimates for this work were submitted in March and approved by the Chief of Engineers, under date of May 31, 1899. Slightly modified plans were submitted in June, to embody changes—with a view to securing dryness—recommended by The Board of Engineers, and said plans were approved on the 24th of June. An allotment of $13,500 from the above-mentioned act was made for construction under date of May 31, 1899. Up to June 30, 1899, no active field work had been undertaken.

During the year active work was commenced early in July, and by the end of the calendar year all construction work was completed except the lining of the casemate—left unfinished to watch progress of dampness. Owing to the location, no earth excavation was necessary for the casemate proper, but 480 cubic yards of earth were removed for the cable conduit. Considerable cutting had to be done through the thick masonry and concrete work of the old fort for the needed door and window openings, etc. About 800 cubic yards of concrete were used in the new walls, conduits, etc., and 480 feet of double-strength vitrified pipe were used in the cable conduit. Throughout the construction of this work, care has been taken to make the casemate free from dampness by means of air spaces, windows, and other precautions, and when the waterproofing and unfinished lining is completed, it is contemplated that this end will be accomplished.

For further details as to construction, etc., attention is invited to the report appended herewith of Assistant Engineer, William M. Hall, who was in immediate charge throughout.

Money statement.

July 1, 1899, balance unexpended	$13,500.00
June 30, 1900, amount expended during the year	11,820.94
July 1, 1900, balance unexpended	1,679.06
July 1, 1900, outstanding liabilities	50.00
July 1, 1900, balance available	1,629.06

REPORT OF MR. WILLIAM M. HALL, ASSISTANT ENGINEER.

I have the honor to submit the following report upon the construction of a mining casemate and cable way for the defense of New Bedford, Mass.

The casemate is a single room about 16 feet by 17 feet inside of lining, with a 16-inch air space between lining and concrete walls on three sides of the room and over ceiling. The concrete and masonry walls on three sides are from 13 feet to 25 feet thick, and the masonry on the other side is of granite and concrete, and from 5 feet to 7 feet thick. Over top of casemate is an arch 2 feet 4 inches thick at crown and on top of that a block of concrete 6 feet thick, making the total amount of new concrete used in constructing casemate 824 cubic yards.

The casemate on the northerly side (the side not accessible by projectiles from sea) is fitted with a door and three windows. The openings were cut through the wall. At the window openings, the wall was made of hard blue Maine granite 4 feet 4 inches thick, and at the door opening, of granite and concrete 7 feet thick. These door and window openings are covered with 3-inch outside shutters of pine. In placing concrete for walls of casemate it was necessary to cut several openings through the floor of the old work. The material encountered was, beginning at top, 4 inches of flagging stone underlaid with from 8 inches to 36 inches or more of concrete, which was supported by brick arches 16 inches thick.

The cable way extends from floor of casemate to edge of sea. In preparing to lay conduit out from casemate it was necessary to cut through lower floor of the old fort and through the foundation wall below ground. In cutting through foundation wall for conduit opening the wall was found to be composed of 2 feet of Maine granite backed with 7 feet of Portland cement concrete, making a wall 9 feet thick.

As stated above, the old arch forms the masonry ceiling of mining casemate, and one side of casemate is formed of the old masonry. Before starting the construction of casemate, this ceiling and wall were very wet after rain storms and during the spring season. In placing concrete over casemate special care was taken to cut the rain water off and turn it away from the interior of casemate.

After cutting the doorway for casemate we discovered that in damp or wet weather water percolated through the wall along the surface between the granite and concrete filling, causing a continuous drip in this doorway during damp weather, and also at one point between door and window causing dampness on face of granite wall.

On account of this dampness it was decided in October not to complete the inside lining till the summer of 1900, thereby leaving the ceiling and other masonry exposed so as to see clearly the effect of the spring weather. The spring thaw and rains did not produce any dampness on ceiling or on new concrete walls, but it produced much dampness in doorway and on face of granite between door and windows. As it has not yet been decided what remedy is to be applied to stop this dampness, the casemate is not yet entirely finished.

It is accessible by three manholes and the two ends. It is built of concrete and has an opening of 2½ feet wide by 3½ feet high from floor of casemate to the first manhole, 24 feet distant. From the first manhole to the sea end, 480 feet, it is of 24-inch double-strength vitrified pipe. Each 2½-foot piece of this pipe was guaranteed to stand a load of 20,000 pounds when placed between two wooden blocks 18 by 24 inches and shaped to the pipe.

The pipe is laid on a uniform grade from first manhole (inside bore elevated 3 feet above mean low water) to sea (inside bore elevated 0.1 above mean low water). The conduit orifice at sea end is covered by a water gate to stop the entrance of sand and drift.

The rate of progress upon these structures is indicated by the following chronological table:

Commenced work July 6, 1899.
Commenced placing concrete for casement walls August 16, 1899.
Completed placing concrete for casement walls September 15, 1899.
Commenced laying 24-inch pipe conduit for cable way September, 18, 1899.
Completed laying 24-inch pipe conduit for cable way September 30, 1899.
Completed covering pipe and cleaning up grounds October 18, 1899.
Stopped work on lining casemate October 20, 1899.
Completed doors, windows, and outside shutters December 9, 1899.
Compteted water supply November 20, 1899.

Total expense on account of the work is as follows:

	Material.	Labor.	Total.
Cutting openings through granite and concrete walls for doors, windows, and conduit	$25.93	$1,508.41	$1,534.34
Erecting concrete walls	2,319.95	3,623.69	5,943.64
Making and placing doors, windows, and shutters, and putting in lining	270.29	331.14	601.43
Laying pipe and putting in manhole for water supply	198.05	52.88	250.93
Miscellaneous charges	187.76	617.77	805.53
Excavating for and laying cable conduit	739.68	1,725.39	2,465.07
Testing cement	....	50.00	50.00
Watching and maintaining casemate and mining equipment	....	220.00	220.00
Total	3,741.66	8,129.28	11,870.94

The only work remaining to be done on these structures is the putting on of waterproofing so as to exclude the water from casemate, and then completing the lining of casemate.

Cable tank.—Under the provisions of the act of Congress approved May 7, 1898, for "Torpedoes for Harbor Defense," the Chief of Engineers, under date of November 6, 1898, directed that plans and estimates be submitted for the construction of a concrete cable tank for the wet storage of torpedo cable. Plans and estimates for constructing a cable tank 23 feet by 15 feet were submitted and approved in December, 1898, and on the 17th of the same month $3,400 was allotted from the above-mentioned act for construction. Up to June 30, 1899, the site for tank had been staked out, the excavation of pit for the tank almost completed, and the necessary drainpipe laid from the pit to edge of the sea.

During the year: Work in progress at the beginning of the year was continued, and by the middle of October all construction work and appliances were completed and the submarine cable on hand at this point stored in the tank before the middle of November. No other work was done during the year save that of maintenance.

This work was in the immediate charge of Assistant Engineer William M. Hall. For details of construction and cost, see his report, appended herewith.

Money statement.

July 1, 1899, balance unexpended	$3,324.05
June 30, 1900, amount expended during the year	3,292.38
July 1, 1900, balance unexpended and available	31.67

REPORT OF MR. WILLIAM M. HALL, ASSISTANT ENGINEER.

I have the honor to submit the following report upon the construction of one cable tank and appliances at New Bedford, Mass., for the fiscal year ending June 30, 1900.

The entire outfit consists of a concrete tank 7 feet deep by 23 feet long by 15 feet wide inside; a 1½-inch water-supply pipe, an 8-inch iron blow-off pipe, an outside tramway track of 30-inch gauge, a car for transferring cables from wharf to tank, a cable transfer and a cable traveler for hoisting and transferring cables from car to tank, and a house covering tank, transfer, traveler, etc.

When I made my last annual report, the material for the work was being received, the blow-off pipe laid, the excavation for tank made, and preparation for commencing the concrete work under way.

The rate of progress upon the structure is indicated by the following chronological table:

The laying of blow-off pipe commenced June 26, 1899.
Concrete and grillage foundation laid July 3, 1899.
Concrete walls were placed July 8, 1899.
Forming timbers outside of walls removed July 14, 1899.
Building over tank commenced on July 15, 1899.
Cable traveler and transfer commenced August 7, 1899.
Tank house and transfer completed September 30, 1899.
Traveler completed November 6, 1899.
The tramway track to tank and grading about tank, etc., completed October 14, 1899.
The sowing of grass seed completed October 18, 1899.
Three cables were stored in tank November 11, 1899.

From tank to seashore the 8-inch blow-off pipe was laid in a ditch from 1 foot to 5 feet deep. The sea end of this pipe is about 2 feet above bottom of sea. The 1½-inch water-supply pipe was laid in a trench from 3 to 3½ feet deep. It is fitted with a 1½-inch gate valve for turning on and off the water, and a 1-inch gate valve for emptying the pipe.

The floor of the tank is at an elevation of 3 feet above mean low water and the top of the side walls is at an elevation of 10 feet.

The tank is formed on a sandy clay which holds water almost like puddle. It is firm, but, on account of the large amount of water which it always holds, is easily penetrated with a bar.

The foundation of tank for floor and side walls is composed of a timber grillage made of two layers of timber crossed and embedded in concrete. The lower layer of timber is of 10-inch by 10-inch material and the upper one of 8-inch by 8-inch. The bottom of this foundation is at elevation 1 foot above mean low water and is 2 feet thick.

The concrete for tank was mixed, by volume, 1 part of Rosendale cement, 2 parts sand, 2 parts gravel, 3 parts crushed stone. The facing was composed of 1 part Portland cement, 2 parts of sand.

The ground about tank was nicely graded and sown with lawn grass. In grading, the level of earth just outside of tank is 1 foot below top of tank. From that elevation it slopes down gently in all directions.

The quantities of work done are as follows:

8-inch iron pipe laid	linear feet..	274
1½-inch iron pipe laid	do....	329
Riprap stone about sea end of 8-inch pipe	cubic yards..	124
Excavation for foundation of tank	do....	398
Grillage timber in foundation of tank	feet B. M..	2,790
Natural cement concrete in foundation and walls	cubic yards..	157
Portland cement facing for floors, inside and top of walls	do....	21
Flagging for steps to doorway	square feet..	38
Vitrified pipe for overflow and drainage, 3-inch	linear feet..	24
Vitrified pipe for overflow and drainage, 6-inch	do....	48
Manholes to water supply		1
Building over tank:		
Lumber in building	feet B. M..	8,312
Shingles	number..	10,000
Doors	do....	2

The total expense on account of the entire work, including the small amount expended before June 30, 1899, is as follows:

	Material, tools, etc.	Labor.	Total.
Tools and plant, additions and repairs	$102.99	$37.00	$139.99
8-inch iron drainpipe for tank in place	213.74	126.38	340.12
1½-inch water-supply pipe in place	176.63	91.10	267.73
Excavation for tank foundation		259.74	259.74
Foundation grillage in place		25.00	25.00
Concrete forming timbers, framing, erecting, and removing		178.56	178.56
Mixing and placing concrete	17.70	193.16	210.86
Overflow pipe, drainage of grounds, etc		15.00	15.00
Tank house, erecting, painting, etc	395.47	402.74	798.21
Stone doorstep in place		28.15	28.15
Tramway track		32.50	32.50
Traveler track		20.60	20.60
Transfer and traveler	101.62	152.55	254.17
Traveler hoist	116.00	30.00	146.00
Fill about tank, grading, etc		237.10	237.10
Sowing the ground with grass seed		20.00	20.00
Purchasing and inspecting material		100.00	100.00
Watching plant and excluding public from grounds		104.60	104.60
Storing cables		18.00	18.00
Maintenance and watching tank and cables		172.00	172.00
Total	1,124.15	2,244.18	3,368.33

Nearly all the materials used in making the concrete were materials left over from the construction of the emplacement for 8-inch rifles. The tank has been in service for storing cables since November 11, and has given no trouble, and has caused no expense for repairs. All the parts perform the service required with entire satisfaction.

Installation of range and position finder.—Under date of June 27, 1900, authority was received and an allotment of $25 made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, for the installation at this post of a "type B" range finder. Up to the close of the year no work had been done, because the location for this finder had not been definitely decided upon.

Money statement.

Amount allotted	$25.00
July 1, 1900, balance unexpended and available	25.00

Preservation and repair.—On April 22, 1899, an estimate was submitted for the preservation and repair of the works on this reservation up to June 30, 1900, and under date of June 9, 1899, an allotment of $400 from the act of March 3, 1899, was made therefor, but up to the end of the year no work had been done under this allotment.

Under date of July 29, 1899, authority was received and an allotment of $150 made from the above-mentioned act to correct dampness in the rooms of the new 8-inch gun emplacements at this place, but no work of this nature was done during the year.

Under date of August 1, 1899, authority was received and an allotment of $250 made from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for the storage and care of mining material for defense of New Bedford Harbor, Massachusetts. Under this head all submarine mining material received at this point during the past and present fiscal year was carefully watched and maintained in good condition. The regular semiannual inspection of all submarine mining material at this place was made the latter part of May and report thereon submitted June 8, 1900. Under date of June 21, 1900, the sum of $350 was allotted from the appropriation for "Preservation and Repair of Fortifications" ($234.43 from the act of March 3, 1899, and $115.57 from the act of May 25, 1900) to be applied to wiring the mining casemate at this post, and for the care and preservation of the torpedo material pertaining to the defense of New Bedford for the fiscal year ending June 30, 1901.

Under date of June 13, 1900, an allotment of $420 was made from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, for necessary miscellaneous repairs needed at this post up to June 30, 1901.

Money statements.

PRESERVATION AND REPAIR.

July 1, 1899, balance unexpended		$400.00
Amount allotted since		420.00
July 1, 1900, balance unexpended and available		820.00

DAMPNESS IN BATTERIES.

July 1, 1899, balance unexpended		$150.00
July 1, 1900, balance unexpended and available		150.00

STORAGE AND CARE OF MINING MATERIAL.

Amount allotted		$600.00
June 30, 1900, amount expended during the year	$246.71	
Amount restored to appropriation	3.29	
		250.00
July 1, 1900, balance unexpended and available		350.00

NARRAGANSETT BAY, RHODE ISLAND.

Mortar battery for sixteen 12-inch mortars.—This work, constructed under the provisions of the act for "Gun and Mortar Batteries," approved June 6, 1896, was completed in 1898, having been turned over to the garrison for use and care on June 6 of that year.

During the past fiscal year: All Engineer Department work at this battery during the year, consisting of constructing ventilating shafts, building shelters for projectiles, care of storage-battery plant for electric lighting, and minor repairs, etc., was done with preservation and repair funds, for further details of which attention is invited to report for "Preservation and Repair," herewith.

The four vertical ventilating shafts, built at the ends of the traverse galleries, have greatly reduced the dampness in the galleries and magazines. They are each 2 feet in diameter, lined with artificial stone pipe, and asphalted. Each has a weather ventilator on top to keep out snow and rain, and can be closed at the bottom in winter when necessary.

Under date of June 9, 1900, the storage-battery plant for electric lighting was formally transferred to the garrison for use and care.

Money statement.

July 1, 1899, balance unexpended	$70.92
June 30, 1900, amount expended during the year	12.51
July 1, 1900, balance unexpended	58.41
July 1, 1900, outstanding liabilities	36.75
July 1, 1900, balance available	21.66

Battery commander's station.—Under date of April 19, 1899, an estimate was submitted for construction of a battery commander's station for the battery of two 10-inch guns, and on April 21, an allotment of $2,420 was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, for construction. At the beginning of the fiscal year preparations were being made for commencement of this work.

During the year: The plans for this station (modified "high-site" type) were approved by the Chief of Engineers on September 6, 1899, and construction work was commenced the same month. As work progressed it was found that to build as planned would cost considerably more than the original estimate, owing to the character of the site and the advance in cost of such materials as cement and steel, so a revised estimate of cost was submitted October 9 and approved October 13, and an additional allotment of $935 made at the same time from the above-mentioned act.

All the excavation, concrete, grading, carpenter and painting work was done by hired labor, but the ironwork was furnished and erected under an agreement with Mr. James H. Tower, of Providence, R. I., for $1,279.

By the end of May all construction work connected with this station was completed, and the same was transferred to the garrison for use and care on June 19, 1900.

Money statement.

July 1, 1899, balance unexpended	$2,420.00
Amount allotted since	935.00
	3,355.00
June 30, 1900, amount expended during the year	3,288.57
July 1, 1900, balance unexpended	66.43
July 1, 1900, outstanding liabilities	55.16
July 1, 1900, balance available	11.27

Cable tank.—Under the provisions of the acts making appropriations for "Torpedoes for Harbor Defense," approved June 6, 1896, and March 3, 1897, a concrete cable tank was completed in April, 1898. Owing to the partial filling in of the adjacent "basin" by the Quartermaster's Department, it became necessary to readjust the discharge pipe leading from the cable tank. An estimate was submitted for this work under date of November 7, 1899, and on the 10th of that month authority was received and an allotment of $300 made from the act of March 3, 1897, for this work.

The necessary pipe was ordered in November, and during December 175 feet of pipe were received and laid in place, completing all proposed work.

Money statement.

Amount allotted November 10, 1899	$300.00
June 30, 1900, amount expended during the year	203.69
July 1, 1900, balance unexpended and available	96.31

Preservation and repair.—Estimates were submitted in April, 1899, for preservation and repairs needed up to June 30, 1900, and in June, 1899, an allotment of $1,745 was made from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for the preservation and repair of the various works on this reservation.

During the year the work of rebuilding a dangerous portion of the parade wall, repairing the engineer carpenter shop, and the scraping and painting of the I-beams of the mortar battery and 10-inch gun battery, in progress at the commencement of the fiscal year under old allotments, was completed early in the year.

Under date of July 29, 1899, authority was received and an allotment of $245 made from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for correcting dampness in the rooms of the new works, but up to the end of the fiscal year no work of this nature was done under said allotment.

A ventilating shaft 2 feet in diameter was built at the end of the second traverse gallery in the mortar battery during July with funds already on hand.

Under date of August 1, 1899, $500 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for storage and care of mining material for defense of Narragansett Bay, Rhode Island, up to June 30, 1900. This class of work (based on Department instructions of December 23, 1898) had been continued during the year. All submarine-mining material intended for both entrances of Narragansett Bay (including "Class A" articles in air-tight cans, securely boxed), which was collected and stored the previous year in the brick torpedo storehouse and concrete cable tank, was carefully watched and maintained in good condition. The regular semiannual inspection of all submarine-mining material was made the latter part of May, and report thereon submitted June 8, 1900.

Under date of June 21, 1900, the sum of $600 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, to be applied to wiring the mining casemate at this post and for the care and preservation of the torpedo material pertaining to the defense of Narragansett Bay, Rhode Island, for the fiscal year ending June 30, 1901.

Under date of August 11, 1899, authority was received and an allot ment of $250 made to construct outside shelters for protecting the projectiles of the mortar battery, and during the month of September five shelters were constructed and painted and three of them placed in immediate use.

During the month of August some minor repairs were made to the cobblestone pavement in the north sally port.

Under date of September 19, 1899, authority was received to construct three more ventilating shafts in the mortar battery, and this work was all satisfactorily completed by the end of December.

A door in the wall leading to parapet near the post adjutant's office was hung, painted, and suitable lock placed; and an opening for ventilating purposes, 10 feet wide and as high as the archway would permit, was cut through the partition at the rear of squad room No. 22.

Under date of December 29 authority was received and an allotment of $300 made from the appropriation for "Preservation and Repair of Fortifications," acts of May 7, 1898, and March 3, 1899, for continuing the care and operation of the electric-light storage battery of the mortar battery, which class of work was continued by the skilled workmen in charge of torpedo plant until said storage battery was transferred for use and care to the garrison in June, 1900.

During May, 1900, the parapet around the new ventilators of the mortar battery was repaired and the culvert under the road at the east end of said battery cleaned out.

On May 19, 1900, an estimate was submitted for the preservation and repair of the various works on this reservation up to June 30, 1901, and under date of June 13, 1900, an allotment of $865 made therefor.

The bill in equity brought to have the true boundary line of the reservation determined is still pending in the United States circuit court. Nothing has been done in regard to this matter during the past year.

Money statements.

PRESERVATION AND REPAIR.

July 1, 1899, balance unexpended	$5,713.09
Amount allotted since	1,165.00
	6,878.09
June 30, 1900, amount expended during the year	5,998.50
July 1, 1900, balance unexpended	879.59
July 1, 1900, outstanding liabilities	2.02
July 1, 1900, balance available	877.57

CARE OF MINING MATERIAL, NARRAGANSETT BAY.

July 1, 1899, balance unexpended		$17.04
Amount allotted since		1,100.00
		1,117.04
June 30, 1900, amount expended during the year	$440.35	
Amount restored to appropriation	76.69	
		517.04
July 1, 1900, balance unexpended and available		600.00

SHELTERS FOR PROJECTILES.

Amount allotted		$250.00
June 30, 1900, amount expended during the year	$225.67	
Amount restored to appropriation	24.33	
		250.00

PREVENTION OF DAMPNESS.

July 1, 1899, balance unexpended	$245.00
July 1, 1900, balance unexpended and available	245.00

Two 12-inch-gun emplacements on nondisappearing carriages.—Under date of March 20, 1899, an allotment of $13,000 from the act of May 7, 1898, for "Gun and Mortar Batteries," was made for the completion of the two 12-inch-gun emplacements which had been in course of construction since March, 1898, with "National Defense" funds. For details as to work already done attention is invited to page 742, Part I, Annual Report of the Chief of Engineers, 1899. At the beginning of the fiscal year this work was about 90 per cent completed.

During the year the earth parapet and sodding of slopes were completed, two pairs of iron stairways were mounted, foundation for engine and dynamo built, the artificial bank on south side of the reservation protected with large granite stone, the battery washed with a waterproofing solution, and a complete electric light and power plant installed and satisfactorily tested in all the requirements. A leak over the dynamo room is being repaired by "Preservation and Repair of Fortifications" funds, to which report attention is invited for further details.

The close of the fiscal year finds this work practically completed and about ready to be transferred to the artillery branch of the Army for use and care.

The construction and repair work was in the immediate charge of Inspector L. S. Johnson, to whose appended report attention is invited for details and cost. The electric-light plant was in charge of Mr. Charles B. Raub, as inspector.

Money statement.

July 1, 1899, balance unexpended	$13,000.00
June 30, 1900, amount expended during the year	12,555.77
July 1, 1900, balance unexpended	444.23
July 1, 1900, outstanding liabilities	168.87
July 1, 1900, balance available	275.36

REPORT OF MR. L. S. JOHNSON, INSPECTOR.

Under date of April 25, 1898, the Chief of Engineers directed the construction of two emplacements for 12-inch B. L. rifles on barbette carriages at entrance to Narragansett Bay.

At the commencement of the present fiscal year the battery was nearly completed, the installation of the electric-light plant and a few minor details only remaining to be done.

A full report of the details of construction will be found in the Report of the Chief of Engineers for 1899, Part I, page 742, to which attention is invited.

During the fiscal year the shaping and tamping of the earth parapet in the rear of the battery was completed and the slopes covered with sod, 915 square yards being used. This sod, as well as that reported in the last fiscal year, having been laid during dry, hot months, required daily watering and much attention, but is all growing nicely now.

The two pairs of iron stairways were mounted, a few yards of concrete laid, 198 cubic yards of Rosendale and 19 yards of Portland concrete and 17 yards of Portland facing being used in completing the roadway and in engine and dynamo foundations and in backing for the epaulement wing wall, the hand rails were completed, the I-beams, trolley tracks, trolleys, lifts, stairs, hand rails, doors, etc., were painted, the machinery, pipe, and plant in general was cleaned and put in first-class condition, the costs of which are reported under the proper heads in the summary of cost.

The sea began making inroads on the artificial bank on south side of the reservation, and to prevent further encroachment 1,025 cubic yards of large granite stones were quarried and placed. This was easily and cheaply done, owing to the proximity of the stone, the quarry derrick being able to deposit the stone in place. The protection seems adequate, since no further inroads have occurred.

The entire battery was washed with the waterproofing solution recommended in letter of the Chief of Engineers dated June 20, 1899. As the battery was already practically dry, no effect has been observed.

The carriages and guns were scraped and sandpapered and painted with the regulation colors. In addition they have been traversed somewhat each day and kept thoroughly protected from the weather by a free use of petrolatum. They are now in first-class condition. Racks were forged and mounted for storage of sponges and rammers. The shot trucks and trays were painted, etc.

The stone-filled head of the dock is inclined to settle into the mud, which has made it necessary to resurface it several times. The dock was constructed with the expectation of building a permanent stone wall about it, sheet piling of only sufficient size to last a year or two being used to retain the stone with which it was filled. This filling was made more cheaply than would be possible at any other time, as it was carted directly from the excavation of the emplacements at no additional cost to the Department, thereby saving at least $5,000. The dock sides and top now show signs of weakness and will require attention in the near future.

During the year the contract for supplying and installing an electric-lighting plant was awarded to the New Jersey Foundry and Machine Company. This has been fully mounted and has been satisfactorily tested in all the requirements. The plant consists essentially of a 13 horsepower Hornsby-Akroyd kerosene engine, an Eddy 7½-kilowatt direct-current generator, 60-cell storage battery of the chloride accumulator type, large slate switchboard, panel board, navy standard wire circuits, ventilating fans, firing plugs, lamps, etc.

Cost recapitulation.

Plant, all new and complete	$7,347.00
Buildings, temporary	837.00
Dock, timber, stone-filled	6,349.00
Mounting and care of plant	2,355.00
Supervision and office expenses (including Newport office)	10,349.00
Excavation, granite, 13,700 cubic yards, at $1.56	21,377.00
Embankment, 13,080 cubic yards, at $1.29 (=$1.13 + $0.16)	16,859.00
Sod, 3,756 square yards, at 53 cents (=37½ cents + 15½ cents)	1,983.00
Drainage, 944 linear feet, at 63 cents	593.00
Forms, at 49 cents per cubic yard of concrete	4,485.00
Crushed stone, 176 cubic yards, at $1.92	338.00
Rosendale concrete, 7,690 cubic yards, at $4.69	36,115.00
Portland concrete (including surfaces trowel finished), 941 cubic yards, at $7.40	6,960.00
Portland facing, 570 cubic yards, at $15.64	8,915.00
Mass stone, 750 cubic yards, at $3.10	2,318.00
Gun, anchor, and ringbolts, 5,162 pounds, at 3.8 cents	199.00
Light and communication	5,886.19
Asphalt roofs, 740 square yards, at 88 cents	653.00
Cranes, 4, at $98 each	392.00
Doors, hinges, locks, etc., 21, at $51.33 each	1,078.00
Steel I beams, 68,715 pounds, at 2.1 cents	1,451.00
Lifts, 2 sets, at $848.50 per set	1,697.00
Trolleys and track, 471½ linear feet, at $2.72	1,286.00
Water mains, 1,100 linear feet, at $1.06	1,170.00
Ladders, 4 sets, at $41 per set	164.00
Hand rails, 223 linear feet, at $1.74	388.00
Stairs, 2 sets, at $3.10 per set	620.00
Mounting guns and carriages, 2, at $542.60 each	1,085.20
Care of same, painting, etc., at $470.34 each	940.67
Riprap, 1,025 cubic yards, at $1.11	1,129.00
Waterproofing, lye and alum solutions, 455 squares, at 80 cents per square	364.00
Preservation and repair	695.25
Total cost	146,378.31

After remaining dry through two winters a leak became noticeable in the ceiling of the engine room immediately over the switchboard. A special allotment has been made from appropriation for "Preservation and Repair of Fortifications" to correct this, which work is now in progress.

Nothing further remains to be done except to resurface the dock and grade the grounds.

Emplacements for two 15-pounder rapid-fire guns.—Under the provisions of the deficiency act of Congress, approved July 7, 1898, the Chief of Engineers, under date of October 24, 1898, directed that sites be selected and plans and estimates submitted for the construction of emplacements on which to mount two 15-pounder rapid-fire guns on balanced-pillar mounts. Said plans and estimates were submitted and approved in March, 1899, and an allotment of $11,065 from the above-mentioned act made for their construction.

At the beginning of the fiscal year: Work was commenced in April, 1899, and at the beginning of the present fiscal year this work was practically completed. For details of work done up to June 30, 1899, see page 741, Part I, Annual Report of the Chief of Engineers for 1899.

During the fiscal year: The small amount of concrete and embankment work remaining to be done was completed early in the year. The main stairs and stairs to the magazine were built, and slopes sodded, the battery wired for electric lighting, surfaces washed with a waterproofing solution, and other details done, completing all work but the construction of the loading platform and mounting of guns, which work awaits the arrival of the guns and mounts.

This work was in the immediate charge of Inspector L. S. Johnson throughout. For details as to the construction and cost attention is respectfully invited to his report appended herewith:

Money statement.

July 1, 1899, balance unexpended	$6,738.87
Allotted since	400.00
	7,138.87
June 30, 1900, amount expended during the year	6,399.62
July 1, 1900, balance unexpended	739.25
July 1, 1900, outstanding liabilities	234.00
July 1, 1900, balance available	505.25

REPORT OF MR. L. S. JOHNSON, INSPECTOR.

Under date of October 24, 1898, the Chief of Engineers ordered the construction of two emplacements for 3-inch 15-pounder rapid-fire guns on balanced-pillar mounts at the entrance to Narragansett Bay.

At the beginning of the present fiscal year the concrete had all been laid except the loading platforms and small quantities in the various stairways and floors of magazines. A portion of the foundation fill for the earth parapet had been made by filling a gully with stone. The drainage (except brass gratings, etc.), asphalting, etc., had been completed, hand rails partially constructed, and the doors ready for the fittings.

During the fiscal year: The floors of the magazines and open courts, the top finish on wing wall, and wall finish of the exposed end of the 12-inch battery, the main stairs and stairs to the magazines, loading platforms, and lookout were all completed early in the year, thus finishing all the concrete except the loading platforms which have awaited the arrival of the mounts until the close of the year. This class of work was all trowel finish, and, while requiring but small quantities of material, added considerably to the cost.

Seven hundred and fifty-three cubic yards of earth were placed in the parapet, the earth being furnished by contract at $1.13 per cubic yard, on the work, the tamping and shaping being done by day work. This seems quite a price to pay for earth; but as it was necessary to cart it nearly 2 miles from valuable building lots, it is not excessive. It was thoroughly rammed in horizontal layers and also thoroughly flushed, and is a firm compact bank.

The entire surface of this embankment was sodded, requiring 1,276 yards, for which 37½ cents per yard was paid, to which the cost of laying, 12½ cents, is to be added. This was machine cut and was delivered in rolls, was laid on the surfaced earth, tamped to a good union, and held with pegs driven well into the earth. It is all growing nicely, although laid in very hot, dry weather.

The drainage connections, gratings, etc., were purchased and put in place in all parts of the work, brass fittings being used about the magazines.

The battery was wired for electric lights, current being obtained from the 12-inch battery system.

The door fittings, locks, etc., were purchased and the two doors hung and painted.

The hand rails were constructed on the work, a portion of which work was reported last year. They were also mounted except the portion for the gun platforms, which must await their completion.

The battery was washed with the solutions of lye and alum, but no especial benefit is noted.

Cost recapitulation.

Mounting and care of plant	$506.00
Supervision and office expenses (including Newport office pro rata)	1,037.00
Excavation, 125 cubic yards, at $1.20	150.00
Embankment, 1,013 cubic yards, at $1.23 (=$1.13+$0.10)	1,242.00
Sod and maintenance, 1,276 square yards, at 50 cents (=37½ + 12½ cents)	638.00
Drainage, 155 linear feet, at 39 cents	60.00
Forms, at 62 cents per cubic yard of concrete	655.00
Rosendale concrete, 904 cubic yards, at $4.77	4,311.00
Portland concrete, 19 cubic yards, at $8.20	156.00
Portland facing (including trowel work), 83 cubic yards, at $13.68	1,136.00
Mass stone, 210 cubic yards, at $1.68	353.00
Light and communication	30.10
Asphalting magazines, 30 square yards, at 93 cents	28.00
Doors and fittings, 2, at $51 each	102.00
I-beams	34.00
Hand rails	90.00
Cutting down wing wall	208.00
Total to June 30, 1900	10,736.10

Upon arrival of the gun mounts the loading platforms will be constructed, guns mounted, and the hand rail placed, which will complete the battery.

Preservation and repair.—It being noticed this spring that the dynamo room at the east end of the parados showed increasing dampness, an estimate was submitted under date of May 19, 1900, for the removal of the earth covering and the concrete roof down to the asphalt cover, renewing the same, and sealing the end of the I-beams. Under date of June 5, 1900, authority was received and an allotment made from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to correct this dampness. At the close of the fiscal year this work was in progress. Under date of June 13, 1900, an allotment of $225 was made from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, for necessary miscellaneous repairs needed at this post up to June 30, 1901.

Money statement.

Amount allotted during fiscal year	$975.00
July 1, 1900, outstanding liabilities	278.58
July 1, 1900, balance available	696.42

Sites for fortifications and seacoast defenses.—Under the provisions of the act of Congress of August 18, 1890, the Chief of Engineers United States Army, in August, 1894, directed that negotiations be opened for the purchase of certain land needed for projected fortification purposes.

It being found after a long period of negotiations that there was no prospect of securing the property by amicable arrangements, the owners were notified in March, 1897, that title on the part of the United States would be acquired by condemnation. In August, 1897, and June, 1898, the Secretary of War requested the Attorney-General to institute proceedings for the condemnation of certain tracts of land belonging to W. T. Richards, B. H. Shoemaker, Mary Dame, Lois Anna Greene, G. Norman Liber, and the Ocean Highland Company, and also of the public road between abutting tracts, aggregating in all about 32 acres of land. Descriptions, etc., of all this land were prepared and forwarded to the United States attorney in October, 1897, and June, 1898. A preliminary hearing on the condemnation suit was held at Providence, R. I., on August 1, 1898, and in March, 1899, an understanding as to the price was reached with the owners of the land to be acquired through the condemnation proceedings.

The title to the land desired having finally passed the administrative scrutiny of the United States Attorney-General, authority was received in August to pay into the registry of the United States circuit court, district of Rhode Island, the amount of the awards decided upon in this case, and said awards were paid in September and releases obtained and recorded vesting title in the United States.

At the close of the fiscal year a detailed topographical survey of the land acquired was in progress under an allotment of $1,000 made June 9 from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899.

Funds have been allotted as follows:

August 13, 1895	$150.00	September 19, 1896	$10,500.00
June 13, 1896	100.00	August 17, 1899	66,774.74
July 1, 1896	7,800.00		
July 14, 1896	115,731.20	Total	201,555.94
July 16, 1896	500.00		

Money statements.

CONTINGENCIES.

July 1, 1899, balance unexpended	$28.60
June 30, 1900, amount expended during the year	7.90
July 1, 1900, balance unexpended and available	20.70

PURCHASE OF LAND.

July 1, 1899, balance unexpended	134,031.20
Amount allotted since	66,774.74
	200,805.94
June 30, 1900, amount expended during the year	200,805.94

SURVEY.

Amount allotted	1,000.00
July 1, 1900, outstanding liabilities	215.58
July 1, 1900, balance available	784.42

In May, 1897, authority was received to make a survey of another site with a view to determining whether there will be sufficient room for mounting the guns recommended by The Board of Engineers. This survey was made during March and April, 1899, and map of same platted. A report as to the quantity and price of land required at this place was submitted for Departmental action under date of May 1, 1899. In June, 1899, information was received that the land desired would be obtained by condemnation proceedings, and during the same month full description of the land was forwarded to the United States district attorney for his action.

During the year: Negotiations having progressed toward an early settlement of this case, a provisional allotment of $60,000 was made November 24, 1899, from the appropriation for "Sites for Fortifications and Seacoast Defenses," act of March 3, 1899.

The title to the 31.67 acres of land desired, together with the right of way over a strip of land containing about 1.35 acres, having been approved by the United States Attorney-General, authority was granted by the Secretary of War under date of June 30, 1900, to pay into the United States circuit court, district of Rhode Island, the amount of the awards in this case, and at the close of the year preparations had been completed for said payment.

Money statement.

Amount alloted during fiscal year	$60,000.00
July 1, 1900, balance unexpended and available	60,000.00

Battery for three 10-inch guns on disappearing carriages.—This work, constructed under the provisions of the act for "Gun and Mortar Batteries," approved June 6, 1896, was completed in 1898, having been formally transferred to the artillery for use and care during June of that year.

During the past fiscal year: The locking devices to ammunition lifts of this battery being found to be of the old pattern and faulty, six new ones were installed and altered during July and August, materials were purchased for correcting dampness, and some portion of this work was done, exhausting the available funds for this battery.

Other Engineer Department work at this battery during the year, consisting of care of storage-battery plant for electric lighting, continuation of correction of dampness, and minor repairs, etc., was done with preservation and repair funds, for further details of which attention is invited to report for "Preservation and Repair" below.

Money statement.

July 1, 1899, balance unexpended	$827.87
June 30, 1899, amount expended during the year	827.87

Mortar battery for eight 12-inch mortars.—This work is being constructed under the provisions of the act for "Gun and Mortar Batteries," approved May 7, 1898. The following allotments from this act for said construction have been made: June 17, 1898, $2,500; August 1, 1898, $125,000, and on March 5, 1900, $15,900 was allotted for completion from the act of July 7, 1898.

At the beginning of the fiscal year: Work of construction was commenced in September, 1898, and at the beginning of the fiscal year this battery was about 40 per cent completed, the excavation and drainage for the main work having been practically finished, leaving the concrete work well under way; and four base rings, four racers, and minor parts of eight mortar carriages had been received and moved near the work. For full and detailed description of work done up to June 30, 1898, see page 737, Part 1, of Annual Report of the Chief of Engineers for 1899.

During the past fiscal year all steel I-beams were painted and placed; the mass of the concrete work completed, two concrete mixers being in use part of the time; an asphalt waterproof course was laid above all rooms and passages, and most of the exposed faces of walls and the top surfaces of concrete were painted with a waterproofing mixture; all parts of the eight mortar carriages received and mounted ready for the guns; about 32,000 cubic yards of earth were taken from adjacent borrow pits and used for forming the parapet and traverses, and sodding of slopes practically finished. The battery is now about 95 per cent completed, there remaining to complete the paving in roadways and pits, placing of trolley system (under an agreement made in November), the finishing of the approach road, the repainting of doors, exposed I-beams, etc., and the hauling up and mounting of the eight mortars when they are received from the Ordnance Department.

This work was in the immediate charge of Lieut. R. P. Johnston, Corps of Engineers, throughout the year. For further details in connection with the work, attention is invited to his appended report.

Contracts in force.

Materials.	Contractor.	Date of approval.	To commence.	To complete.
Crushed stone	E. K. Chamberlain, New York, N. Y.	Dec. 9, 1898	Feb. 15, 1899	When ordered.
Rosendale cement	Lawrenceville Cement Co., New York, N. Y.	Jan. 6, 1899	.....do	Do.
Sand	Jeremiah K. Sullivan, Newport, R. I.	Dec. 21, 1898	.....do	Do.
Portland cement	Atlas Cement Co., New York, N. Y.	Dec. 9, 1898	.....do	Do.

Money statement.

July 1, 1899, balance unexpended	$71,759.80
Amount allotted since	15,900.00
	87,659.80
June 30, 1900, amount expended during the year	75,539.48
July 1, 1900, balance unexpended	12,120,32
July 1, 1900, outstanding liabilities	3,091.99
July 1, 1900, balance available	9,028.33

REPORT OF LIEUT. ROBERT P. JOHNSTON, CORPS OF ENGINEERS.

I have the honor to submit the following report of operations on the battery for eight 12-inch B. L. mortars during the fiscal year ending June 30, 1900:

At the close of the last fiscal year it was estimated that the battery was about 40 per cent completed. Plant had been assembled, wharf and road repaired, old buildings repaired and necessary new buildings erected, contracts for most of the materials made and deliveries begun; the excavation had been practically completed, most of the drains laid, the anchor bolts set, and about 350 cubic yards of Portland concrete and 1,822 cubic yards of Rosendale concrete placed. This concrete had been placed in both pits and walls, nearly all of which had been begun, but none finished. Four of the base rings, four racers, and minor parts of all the carriages had been received and hauled to convenient points near the battery.

The working plant at the close of the last fiscal year consisted briefly of a cubical concrete mixer and a system of Hunt railroad tracks and cars for placing the concrete.

During the fiscal year the plant was supplemented by a continuous concrete mixer of the Cockburn-Barrow type and a steel derrick, both transferred from the 12-inch battery, and by a movable railroad track and side dump cars (constructed from old rail and cars on hand), for hauling and placing earth.

The concrete work has been practically completed, asphalt waterproof courses laid, and a waterproofing wash of lye, alum, and cement in water applied to all top surfaces of concrete over rooms and passages and to many exposed vertical surfaces; all interior floors and about two-thirds of the exterior floor surfaces had been paved with Portland cement mortar, speaking tubes placed, insulated conduit and wooden strips for electric wiring placed, the earth fill completed, interior and exterior slopes trimmed and sodded and superior slopes seeded, all of the doors built and all but two of them hung, the remaining mortar carriages received and hauled to the work, and all eight carriages cleaned, repainted, and mounted.

Hence the battery is now completed with the exception of the trolley systems, about one-third of the exterior paving, the approach road, and a few minor details. The mortars have not yet arrived. The proposal of the Brown Hoisting and Conveying Machine Company, of Cleveland, Ohio, for furnishing and installing the trolley systems at a total cost of $1,675 was accepted on November 16, 1899, but on account of the unusual demand for steel and iron work, these trolleys have not yet been put in.

Details of the work: But few new methods have been tried, and hence not much new data of value has been obtained. The following details, however, are worthy of mention:

The cubical concrete mixer and the Hunt track and cars were used until the walls were all built up to the ceiling level, and the concrete used above the ceiling level in the left traverse was also mixed with this mixer and placed with a small derrick. The continuous mixer and the steel derrick were then obtained and used for most of the remaining concrete. This derrick has an 80-foot mast and 80-foot boom, and hence when once placed it can cover a large area and place concrete very economically; but it is very heavy and cumbersome to handle and expensive to erect and take down, and hence its value is doubtful except when great quantities of material can be handled by it from one position.

The continuous mixer and this derrick were so placed that the concrete fell from the mixer into the hoisting tub on a flat car which had to be pushed only a few feet to come in reach of the derrick. As the full tub was pushed out, an empty tub was pushed in, and hence the mixer was kept constantly at work. During a run of fourteen days, 1,400 cubic yards of concrete were mixed and placed in this way, the total labor during this period costing about 76 cents per yard.

Asphalting.—The asphalt course consisted of a hot mixture of 8 parts Neuchatel rock asphalt, 2 parts sand, and 1 part coal tar, spread with rakes and thoroughly ironed with heavy hot irons. The finished course was about three-eighths of an inch thick. The surface of this coat was then painted with a solution of asphalt in naphtha, which was very effective in closing all pores that had not been closed by the ironing. This asphalt course extends to the outer edge of the air spaces. It successfully excludes water, but the water running off of it is stained a dark brown, showing that some ingredient (probably the coal tar) is gradually washing out.

Waterproof wash.—About 2,400 square yards of concrete surface were treated with the waterproof mixed and applied by the methods described by Maj. W. L. Fisk, Corps of Engineers, in Report of Chief of Engineers for 1899, Part I, page 1002. This has been quite effective, but shows a tendency in many places to scale off from the concrete, probably due to applying it too thick.

The following table shows what has been done on this battery from the beginning up to July 1, 1900, and the cost of each item:

Excavation (earth and rock), 22,785 cubic yards, at $1.19	$27,226.52
Fill, 32,564.13 cubic yards, at 37.9 cents	12,345.46
Portland concrete (including all facings), grout, etc., 1,361.86 cubic yards, at $11.81	16,084.17
Rosendale concrete, 7,563.5 cubic yards, at $6.04	45,729.12
Cement paving (Portland), 1,374 square yards, at $1.30	1,787.71
Asphalting, 1,633.2 square yards, at 77 cents	1,267.19
Sodding, 5,595 square yards, at 38.4 cents	2,148.44
Beams, bolts, etc. (including scraping, painting, etc.)	4,375.29
Windows and doors (including bronze fittings)	1,866.35

Mortar carriages (hauling up, cleaning, painting, and mounting)	$2,771.36
Electric conduits and strips	856.40
Speaking tubes	153.92
Drainage and ventilation	7,611.22
Material on hand (to be expended in completing the battery)	2,079.02
Miscellaneous (including plant, superintendence, buildings, water, etc.; in fact, all expenses not stated above)	7,954.09
Total	134,256.26

Battery commander's station.—Under date of April 19, 1898, an estimate was submitted for construction of a battery commander's station for the 10-inch gun battery, and on April 21 an allotment of $4,950 was made from the act of July 7, 1898, for construction. At the beginning of the year preparations had been made for the commencement of this work.

During the year: The plans for this station (modified "high-site" type) were submitted and approved in July, 1899, and an agreement made in August with the New Jersey Foundry and Machine Company, of New York, N. Y., for furnishing and erecting all the iron and steel work for $1,275, all other work to be done by hired labor and purchase of materials. The work of excavation for the foundation was commenced in August, and all engineer work connected with this station was completed early in June, and the same was transferred to the garrison for use and care on June 19, 1900.

This work is in the immediate charge of Lieut. R. P. Johnston, Corps of Engineers. For details, etc., attention is invited to his appended report.

Money statement.

July 1, 1899, balance unexpended	$4,950.00
June 30, 1900, amount expended during the year	3,911.36
July 1, 1900, balance unexpended	1,038.64
July 1, 1900, outstanding liabilities	132.97
July 1, 1900, balance available	905.67

REPORT OF LIEUT. ROBERT P. JOHNSTON, CORPS OF ENGINEERS.

I have the honor to submit the following report of operations on the battery commander's station for the battery of three 10-inch guns during the fiscal year ending June 30, 1900.

Proposal of the New Jersey Foundry and Machine Company for furnishing and erecting the steel work for $1,275 was accepted on August 25, 1899.

Preparations for work were made in September, 1899, sand and stone platforms being constructed and the work staked out. Cement, sand, stone, and lumber were received during that month, but the anchor bolts did not arrive until October. The excavation was begun and completed in October, 1899, 44.7 cubic yards of earth being removed. The concrete work was begun and completed and the anchor bolts set in November, 1899. About 26 cubic yards of Portland concrete was used. One hundred and six linear feet of 4-inch open tile drain was placed around the base of the concrete piers and connected with a drain leading off.

The steel work was delivered, erected, and painted by the contractors in February, 1900.

The remainder of the work, woodwork, roofing, painting, etc., has subsequently been done by day labor, and the station was completed and turned over to the artillery on June 19, 1900.

The total cost was $4,044.33, of which $1,275 was for the steel work, and the remainder was for material and labor on the concrete and woodwork and contingencies.

Mining casemate.—Owing to the exceeding dampness of the permanent mining casemate constructed at this point in 1893 and 1894, the Chief of Engineers, under date of September 8, 1898, directed that plans and estimates for a new casemate that would fulfill the requirements as to freedom from dampness, etc., be submitted, and said plans and estimates were approved in January and May, 1899. Allotments for the construction of this work were made as follows from the act of May 7, 1898: January 13, 1899, $6,640; February 9, 1899, $360, and June 8, 1899, $4,019.16; and $60.84 was allotted June 8, 1899, from act of June 6, 1896. At the beginning of the year preparations had been made for the early construction of this work.

During the year excavation work was commenced and completed in July and concrete work commenced the same month. All steel I-beams were painted and placed, concrete work completed, surfaces waterproofed and asphalted where necessary, about 2,500 cubic yards of earth fill placed and rammed over roof, and slopes trimmed, graded, and sodded. At the close of the year the casemate was about 99 per cent completed, there remaining to complete the fitting up of interior, placing of iron doors, shutters, and ventilators, and a few other minor details.

This work was in the immediate charge of Lieut. R. P. Johnston, Corps of Engineers, throughout the year. For further details in connection with the work attention is invited to his appended report.

Money statement.

July 1, 1899, balance unexpended	$11,080.00
June 30, 1900, amount expended during the year	8,651.45
July 1, 1900, balance unexpended	2,428.55
July 1, 1900, outstanding liabilities	4.60
July 1, 1900, balance available	2,423.95

REPORT OF LIEUT. ROBERT P. JOHNSTON, CORPS OF ENGINEERS.

I have the honor to submit the following report of operations on the construction of a mining casemate during the fiscal year ending June 30, 1900.

Work was begun on July 1, 1899, and the casemate is now complete, with the exception of locks for the door and windows and the proposed splinterproof outer door and shutters. The excavation was done by hand, the materials being removed by one-horse carts. A steam drill borrowed from the mortar battery was used for drilling through the wall of the old casemate. All the concrete was mixed in the cubical mixer at the mortar battery and hauled to the site of the casemate in dump cars running on a Hunt track (borrowed from the mortar battery) and pulled by a small hoisting engine, also borrowed from the mortar battery. No other plant was used in the construction.

All interior woodwork (shelves, tables, etc.) has been completed, anchor bolts for the oil engine set, and the casemate is now ready for the electrical apparatus and connections.

The following table shows the work done and the cost:

Excavation, 729 cubic yards, at 75 cents (about)	$543.88
Drainage, 227 feet, at 16 cents (about)	38.40
Natural concrete, 340 cubic yards, at $7.64 (about)	2,598.45
Portland concrete, 168 cubic yards, at $13.54 (about)	2,274.55
Asphalt roofing, 69.4 square yards, at 25 cents (about)	17.38
Embankment, 2,458.6 cubic yards, at 24 cents (about)	588.45
Lining casemate	67.92
Heating	15.00
Door, with transom	133.47
Window, with shutters	10.80
I-beams	428.11
Sodding, 600 square yards, at 39 cents (about)	235.66
Contingencies	1,703.98
Total	8,656.05

Emplacements for two 15-pounder rapid-fire guns.—Under the provisions of the act making appropriation for "Gun and Mortar Batteries," approved July 7, 1898, the Chief of Engineers, under date of October 24, 1898, directed that the sites be selected and plans and estimates submitted for the construction of emplacements for two 15-pounder rapid-fire guns. Said plans and estimates were submitted and approved in June, 1899, and an allotment of $10,000 made for said work. At the beginning of the fiscal year no active work was in progress.

During the year: During August and September a stone platform was constructed and some few constructing materials received, but as no satisfactory arrangements could be made at that time for obtaining the proper cement authority was granted by the Chief of Engineers, under date of September 29, to defer the construction of the battery until the following spring. In April two of the smoothbore 15-inch guns and carriages of the old battery were dismounted and removed from the site of the work and materials for construction received. The work of excavation was commenced in May and concrete work commenced in June, and both classes of work were in progress at the close of the year.

This work was in the immediate charge of Lieut. R. P. Johnston, Corps of Engineers, throughout the year. For further details in connection with the work attention is invited to his report, appended herewith.

Money statement.

Amount allotted	$10,000.00
June 30, 1900, amount expended during the year	5,205.66
July 1, 1900, balance unexpended	4,794.34
July 1, 1900, outstanding liabilities	1,132.60
July 1, 1900, balance available	3,661.74

REPORT OF LIEUT. ROBERT P. JOHNSTON, CORPS OF ENGINEERS.

I have the honor to submit the following report of operations on the battery for two 15-pounder rapid-fire guns during the fiscal year ending June 30, 1900.

Preparations for handling the material for this battery were begun in September, 1899, and part of the materials were delivered during the fall, but actual work of construction was not begun till April, 1900. Sand and stone platforms were constructed near the site of the battery, and an old building close by was repaired for the storage of cement. Contracts for materials were entered into and deliveries made as follows:

Hudson River Stone and Supply Company, 508.6 cubic yards broken stone, at $2.10	$1,068.06
J. K. Sullivan, 375.9 cubic yards broken stone, at $1.50	563.84
James C. Goff, 685 barrels Rosendale cement, at $1	685.00
James C. Goff, 349 barrels Portland cement, at $2.30	802.70

Plant: The work is being done by hand, 1-horse carts being hired to do the necessary hauling; hence no plant has been provided except ordinary tools, such as picks and shovels, hammers and drills, concrete rammers, wheelbarrows, etc.

Removal of old 15-inch guns: The two old 15-inch guns which formerly occupied the site of the present battery have been dismounted and guns and carriages removed. This work was done by a small force of engineer employees and a small detail of artillery soldiers, working together.

Excavation: Excavation was begun May 7, 1900, and has been carried on at the same time with the concrete work, and only as fast as required by the latter. A great deal of drilling and blasting were necessary in removing the concrete and stone and brick masonry of the old battery. At the end of the fiscal year about 615 cubic yards of masonry and 931 cubic yards of earth had been removed, part of the earth being deposited as fill in the new work. The average cost per yard has been about 81 cents.

Concrete: The walls of both magazines have been built up to the ceiling level, and the retaining wall and parapet of the left emplacement completed. About 55 cubic yards of Portland concrete and 120 cubic yards of Rosendale concrete have been placed in the above walls. All concrete has been mixed by hand.

Beams: Old railroad iron on hand is to be used as ceiling beams over the magazines and bombproof. This rail has been cut in proper lengths and is ready to be placed.

Work is now progressing steadily. The battery is probably about 30 per cent completed, and all the materials necessary for its completion are on hand.

Itemized cost: The work has not progressed sufficiently to enable details of cost to be given.

Preservation and repair.—Estimates were submitted on April 22, 1899, for the preservation and repair of the various works on this reservation up to June 30, 1900, and under date of June 9, 1899, an allotment of $1,111.82 was made therefor from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899.

During the year: Under date of July 29, 1899, authority was received to correct dampness in the 10-inch gun battery with preservation and repair funds already on hand, and under this head the following work was done at this battery: The I-beams and trolley systems were scraped and painted; cracks in slopes were cut out and filled with boiled linseed oil, warmed, and the openings in superior slope sealed with elastic cement; a gutter 40 feet in length constructed on outer (west end) edge of the parapet, and the surfaces on slopes and vertical walls treated with two coats waterproofing solution of lye and alum. The results of the above work have been very satisfactory so far as increased dryness is concerned, and more satisfactory results are anticipated when the repairs yet contemplated are carried out. In addition to the foregoing, the ammunition hoists were supplied with locking devices and readjusted, and other minor repairs made.

At the 6-inch rapid-fire battery a small parade was formed at the rear of the battery by removal of a few cubic yards of earth and a large bowlder; a brick gutter was laid to facilitate drainage; 5 Portland-mortar steps were molded, to lead from natural surface of the ground to the parade; 102 feet of 4-inch open tile drain were laid, a brick catch-basin constructed, and preparations made for paving the parapet, laying drains, etc., under the new allotment.

On May 19, 1900, an estimate was submitted for the preservation and repair of the various works on this reservation up to June 30, 1901, and under date of June 13, 1900, an allotment of $1,730 made therefor.

Money statement.

July 1, 1899, balance unexpended	$1,482.40
Amount allotted since	1,730.00
	3,212.40
June 30, 1900, amount expended during the year	950.85
July 1, 1900, balance unexpended	2,261.55
July 1, 1900, outstanding liabilities	157.28
July 1, 1900, balance available	2,104.27

3 E.

DEFENSES OF EASTERN ENTRANCE TO LONG ISLAND SOUND AND COAST OF CONNECTICUT.

Officer in charge, Maj. Smith S. Leach, Corps of Engineers; assistants, Lieut. William J. Barden, to October 20, 1899, and Lieut. Edward H. Schulz, from October 19 to end of fiscal year; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

DEFENSES OF NEW LONDON.

The defenses of New London consist of Fort Trumbull, on the western side of the harbor, and Fort Griswold, on the eastern side.

Fort Trumbull.—Fort Trumbull occupies a small peninsula jutting out into the Thames River just below the heart of the city. During the past year it has been garrisoned by a battery of the Fourth Artillery. The fort contains no modern guns or carriages.

There have been no funds on hand during the fiscal year. No work has been done by the Engineer Department. Nothing is contemplated.

Fort Griswold.—Fort Griswold is an earthwork mounting barbette guns, situated on the heights opposite Fort Trumbull. The fort is not garrisoned. During the year an ordnance sergeant has been in immediate charge. The armament is all of old type.

Under an allotment of $75 from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, a retaining wall was repaired and certain portions of the parade were regrassed. This work was completed and accepted in December, 1899.

An estimate to the amount of $250, covering needed repairs to the ordnance sergeant's quarters, was forwarded to the Chief of Engineers on January 20, 1900. Funds for above repairs are needed.

No funds are now on hand. No work is contemplated, except as above recommended.

Money statement.

July 1, 1899, balance unexpended	$75.00
June 30, 1900, amount expended during fiscal year	75.00

DEFENSES OF EASTERN ENTRANCE TO LONG ISLAND SOUND.

These works are all in isolated situations, and all material must be transported by water. Landings at certain seasons of the year are sometimes delayed several days. The cost of labor and material for these works is much above the average.

Emplacements for two 12-inch B. L. rifles on United States disappearing carriages, model 1897.—The contract for this battery was entered into December 11, 1896, and includes the construction of a crib wharf at the island. The work was begun in the spring of 1897. At the beginning of the fiscal year the emplacements were practically completed. One carriage was mounted and two rifles had been received. The electric plant had been installed. During the present fiscal year the battery has been completed and transferred to the artillery. The following allotments were received during the year:

$2,500 for alteration and repair of the battery.
$2,000 for waterproofing outside walls.
$2,500 for mounting guns and carriages.

The second carriage was received at the beginning of the fiscal year, and the armament was completely mounted by December, 1899. The covering of the lift openings, placing of a bridge between platforms, and consolidation of slopes were also finished. An electrician sergeant was assigned to the work in November.

This battery was the first constructed in the district. There has been considerable trouble from dampness, as no damp-proofing was introduced. The means used to prevent this were, first, to paint the superior slopes and breast-height with two coats of alum and potash solution; and, secondly, to cover the loading platform with a coat of asphalt and benzine, followed by a mop coat of blended hard and soft asphalt put on hot with sand. The weather was too cold for the proper mixing of sand, and consequently this cover has shown cracking. It is, however, thought that such a covering, put on hot with sand and slightly thicker, will prove a permanent protection. Although too early for definite conclusions, there is no doubt that the moisture has been considerably reduced.

During February and March the ironwork of the battery was thoroughly scraped and cleaned, and painted with a mixture of one-third zinc and two-thirds red lead dissolved in turpentine. The metal was thoroughly heated before application, and two coats were given. This paint has thus far proved the best for ironwork exposed to moisture.

The armament is complete, and includes one type A and two type B position finders.

Services of watchmen were not needed, as a garrison has been on duty.

In obedience to instructions from Headquarters, Department of the East, Lieut. John E. Stephens, Seventh United States Artillery, assumed charge of this battery February 17. A memoir, in six sheets, giving diagrams, descriptions, and regulations for the care of this battery, was prepared in this office and was approved by the Secretary of War. The final transfer of the battery was effected on May 12, and the ordnance and engineer property, including above memoir, was transferred on regular invoices and receipts.

Money statements.

GUN AND MORTAR BATTERIES.

12-inch battery.

July 1, 1899, balance unexpended, act of May 7, 1898	$111.88
June 30, 1900, amount expended during fiscal year	111.88

Mounting guns.

July 1, 1899, balance unexpended	$930.59
June 30, 1900, amount expended during fiscal year	930.59
August 1, 1899, amount allotted	2,500.00
June 30, 1900, amount expended during fiscal year	2,358.11
July 1, 1900, balance available	141.89

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Watchmen.

July 1, 1899, balance unexpended	$2,160.00
June 8, 1900, amount withdrawn	1,900.00
July 1, 1900, balance available	260.00

Care of fortifications.

July 1, 1899, balance unexpended	$310.00
June 30, 1900, amount expended during fiscal year	309.02
July 1, 1900, balance available	.98

Waterproofing.

July 29, 1899, amount allotted	$2,000.00
June 30, 1900, amount expended during fiscal year	1,464.57
July 1, 1900, balance available	535.43

Repairs and alterations, 12-inch emplacements.

September 21, 1899, amount allotted	$2,500.00
June 30, 1900, amount expended during fiscal year	2,500.00

Emplacements for two 10-inch B. L. rifles on United States disappearing carriages, model 1896.—The construction of this battery was begun in March, 1898. By July, 1898, the platforms were ready for the armament. At the beginning of the fiscal year the battery had been entirely completed, electric installation for light and power provided, and switch board arranged for furnishing power to a 30-inch searchlight. During the present year the controlling devices and lifts were placed and the ironwork was completely overhauled and painted. The loading platforms have been covered with asphalt and benzine, followed by a mop coat of hard-and-soft asphalt. It is intended to roll sand in this covering as soon as the weather permits. Some dampness has shown in the galleries of this battery. It is thought this will be overcome by sodding the earthern slopes, which will shed water, and moreover prevent the shifting of sand, which is quite severe at this battery. The exterior slopes are exposed to wind and wave action, and for their ultimate preservation a sea wall will be necessary. The armament is complete.

In obedience to instructions from headquarters, Department of the East, Lieut. John E. Stephens, Seventh United States Artillery, assumed charge of this battery February 17. A memoir in six sheets, giving diagrams, descriptions, and regulations for the care of this battery, was prepared in this office and was approved by the Secretary of War. The final transfer of the battery was effected on May 12, and the ordnance and engineer property (including above memoir) was transferred on regular invoices and receipts.

Money statement.

July 1, 1899, balance unexpended	$60.00
June 30, 1900, amount expended during fiscal year	60.00

Emplacements for two 10-inch B. L. rifles on United States disappearing carriages, model 1896, and a mining casemate.—This work was done under contract with Mairs & Lewis, entered into August 11, 1897, and included the construction of a crib wharf. At the beginning of the fiscal year the battery had been completed, electric-light plant, ammunition lifts, etc., were installed, and the armament mounted. During the present year the battery commander's station pertaining to this battery has been completed and a type A position finder mounted. The ironwork has been painted and the emplacements placed in good condition. The armament is complete, and includes one type A and two type B position finders. The casemate has been completed, battery shelves and operating table set up, and a partition wall is now being built to separate the instruments from the battery room.

In accordance with instructions from Headquarters, Department of the East, Lieut. John E. Stephens, Seventh United States Artillery, assumed charge of this battery on March 7. A memoir in seven sheets, giving diagrams, descriptions, and regulations for the care of this battery, was prepared in this office and was approved by the Secretary of War. The final transfer of this battery was effected on March 22, and the ordnance and engineer property, including above memoir, was transferred on regular invoices and receipts.

Money statements.

GUN AND MORTAR BATTERIES.

Contract work.

July 1, 1899, balance unexpended	$8,148.90
June 30, 1900, amount expended during fiscal year	1,741.84
August 24, 1899, deposited to the credit of Treasurer United States	6,407.06

Battery commander's station.

July 1, 1899, balance unexpended	$2,004.00
June 30, 1900, amount expended during fiscal year	2,004.00

10-inch battery.

July 1, 1899, balance unexpended	$2,500.00
June 30, 1900, amount expended during fiscal year	2,500.00

MINING CASEMATE.

July 1, 1899, balance unexpended	$86.13
June 30, 1900, amount expended during fiscal year	86.13

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$310.00
June 30, 1900, amount expended during fiscal year	310.00
June 8, 1900, amount allotted	250.00
July 1, 1900, balance available	250.00

Emplacements for eight 12-inch B. L. steel mortars.—Plans for this battery were made and approved in the early part of 1898. The work was begun about July 1, 1898. The material was hauled on a railroad track leading from the dock to the site. Sand and aggregate for the concrete were obtained near the site. The materials for concrete are assembled in overhead storage bins and discharged through chutes into cars. The latter, containing gauged proportions of materials, are hauled up an incline, run on a circle track around the mixing platform, unloaded, and returned by gravity to the tunnel under the bins, thus making the complete circuit.

At the beginning of the fiscal year 31,000 cubic yards of excavation had been completed; 130 yards of dry rubble wall and 8,300 cubic yards of concrete had been placed.

During the present year the battery has been completed, except a portion of the earthwork and sodding.

The contract for generating plant has been made.

The armament has been turned over to the garrison to be mounted. One mortar carriage and one mortar in the right pit are mounted and one carriage is partially assembled. The armament is on hand and is expected to be completely mounted by September 1.

During the year a battery commander's station for this battery was begun and completed.

The electric plant for this battery, when finally installed, will also furnish power to the 6-inch battery, and to the 5-inch and 4.7-inch rapid-fire emplacements.

Money statements.

MORTAR BATTERY.

July 1, 1899, balance unexpended		$50,443.07
June 30, 1900, amount expended during fiscal year		43,321.43
July 1, 1900, balance unexpended		7,121.64
July 1, 1900, outstanding liabilities	$250.00	
July 1, 1900, amount covered by contract	3,500.00	
		3,750.00
July 1, 1900, balance available		3,371.64

BATTERY COMMANDER'S STATION.

July 1, 1899, balance unexpended	2,004.00
June 30, 1900, amount expended during fiscal year	2,004.00

Abstract of proposals for electric-light plant received in response to advertisement dated January 30, 1900, and opened March 2, 1900, by Maj. Smith S. Leach, Corps of Engineers, United States Army.

No. of proposal.	Name of bidder.	Date of delivery.	Price bid for entire plant.	Kind and make of boiler.	Kind and make of engine.	Kind and make of dynamo.
1	Edward Heaton, New York, N.Y.	June 1	$7,609	Ames Iron Works.	Buffalo Forge	Ridgeway Type or Northern Electric Co.
2	J. F. Buchanan & Co., Philadelphia, Pa.	do	8,000	Coatesville Boiler Co.	General Electric	General Electric.
3	B. O. Ellis, New York, N. Y.	Apr. 20	6,999	Beggs & Co	Buffalo Forge	Crocker-Wheeler or Eddy.
4	Belknap Motor Co., Portland, Me.	Apr. 25	7,396	Portland Co	New York Steam Power Co.	Belknap.
5	United Engineering and Contracting Co., New York, N. Y.	May 15	7,973			Fort Wayne.
6	McKay Engineering Co., Baltimore, Md.	Apr. 20	6,570	Basshor	Buffalo Forge	Crocker-Wheeler or Northern Co.
7	Walworth Construction and Supply Co., Boston, Mass.	7 weeks.	7,843			
8	Hewitt & Worden, Newburg, N. Y.	May 20	6,830	Delaney	Forbes	Lundell.
9	New Jersey Foundry and Machine Co., New York, N. Y.	May 10	a6,482	Fippett & Wood	Buffalo Forge	Eddy.

[a] Recommended for acceptance.

Abstract of proposals for electric-light plant received in response to advertisement dated January 30, 1900, and opened March 2, 1900, by Maj. Smith S. Leach, Corps of Engineers, United States Army—Continued.

No. of proposal.	Name of bidder.	Kind and make of storage battery.	Alternative prices bid.	Remarks.
1	Edward Heaton, New York, N. Y.	Chloride accumulator..	Crocker-Wheeler dynamo, $200 extra; Westinghouse engine and dynamo, $990 extra; making bid $8,599.	Defective; diagram omitted.
2	J. F. Buchanan & Co., Philadelphia, Pa.	Electric Storage Battery Co. of Philadelphia, Pa.	....	
3	B. O. Ellis, New York, N. Y.	Electric Storage Battery Co.	With Willard storage battery, $6,624.	
4	Belknap Motor Co., Portland, Me.	.....do	....	
5	United Engineering and Contracting Co., New York, N. Y.	.....do	Forbes engine, $300 extra; Payne engine, $450; Bullitt generator, $200.	Defective; diagram omitted; make of boiler and engine bid on not stated.
6	McKay Engineering Co., Baltimore, Md.	Willard storage battery; electric storage battery.	....	
7	Walworth Construction and Supply Co., Boston, Mass.	Electric storage battery.	....	Defective; bid not in conformity with specifications.
8	Hewitt & Worden, Newburg, N. Y.	.....do	....	Defective; no revenue stamps.
9	New Jersey Foundry and Machine Co., New York, N. Y.	Willard storage battery.	With chloride accumulator glass jars, $6,995.	

Contract in force during the fiscal year.

With New Jersey Foundry and Machine Company, New York, N. Y., for furnishing an electric-light plant; contract entered into April 11, approved April 18; expiration, May 25, 1900.

Emplacements for two 6-inch rapid-fire guns on disappearing mounts.—At the beginning of the fiscal year the materials had been negotiated for and excavation partly made. During the present year, and especially this spring, the work has been vigorously prosecuted, and is now practically completed except consolidation of slopes and electric lighting. The carriages are on hand.

Money statement.

July 1, 1899, balance unexpended		$49,675.00
June 30, 1900, amount expended during fiscal year		28,173.40
July 1, 1900, balance unexpended		21,501.60
July 1, 1900, outstanding liabilities	$7,950.78	
July 1, 1900, amount covered by contract	1,850.00	
		9,800.78
July 1, 1900, balance available		11,700.82

Abstract of proposals for ammunition hoists and doors received in response to advertisement dated January 17, 1900, and opened February 17, 1900, by Maj. Smith S. Leach, Corps of Engineers, United States Army.

No. of proposal.	Name of bidder.	Lump price for 5 hoists and doors for 6-inch emplacements.		Lump price for 2 hoists and doors for 10-inch emplacements.		Lump price for 2 hoists and doors for 12-inch emplacements.		Date of delivery.
		Price with bronze gear.	Price with gears per plan.	Price with bronze gears.	Price with gears per plan.	Price with bronze gears.	Price with gears per plan.	
1	Exeter Machine Works, Pittston, Pa.	$4,754.00	$4,598.00	$2,138.00	$2,063.00	$2,682.00	$2,596.00	June 30, 1900
2	Burdett, Rowntree Manufacturing Co., Chicago, Ill.	11,500.00	11,000.00	5,900.00	5,600.00	6,800.00	6,400.00	May 15, 1900
3	Hoffman Engineering and Constructing Co., Philadelphia, Pa.	5,967.00	5,781.00	3,621.00	3,509.00	3,957.00	3,845.00	....
4	The Thos. Laughlin Co., Portland, Me.	....	3,420.00	....	2,595.00	....	2,420.00	May 15, 1900
5	Greenlie, Wyatt & Co., New York, N. Y.	2,917.00	2,867.00	1,827.00	[a] 1,807.00	1,867.00	[a] 1,847.00	June 30, 1900
6	Robt. S. Bishop, New York, N. Y.	3,275.00	3,250.00	2,150.00	2,100.00	2,200.00	2,150.00	July 31, 1900
7	Ellicott Machine Co., Baltimore, Md.	2,825.00	[a] 2,765.00	2,149.00	2,115.00	1,940.00	1,890.00	June 30, 1900
8	Geo. C. Howard, Philadelphia, Pa.	....	5,192.00	....	2,466.00	....	3,194.00	....
9	Chas. F. Chaney, New London, Conn.	6,029.00	5,865.40	2,275.00	2,200.00	2,850.00	2,745.00	July 1, 1900
10	Arthur Falkenau, Philadelphia, Pa.	4,650.00	4,600.00	3,765.00	3,700.00	3,865.00	3,800.00	June 15, 1900

[a] Recommended for acceptance.

Two of the 6-inch hoists pertain to this work.

Contracts in force during the fiscal year.

With Ellicott Machine Company, Baltimore, Md., for two hoists and doors for 6-inch emplacements. Contract entered into March 7, 1900; approved March 20, 1900; expiration, June 30, 1900.

Emplacement for a 4.7-inch Armstrong rapid-fire gun on pedestal mount.—At the beginning of the fiscal year the gun was mounted. Some finishing work was still required on the concrete. During the present year the emplacement has been completed and formally transferred to the artillery on March 26, 1900.

The armament is complete.

Emplacement for 5-inch rapid-fire wire-wound gun.—An allotment for this work was obtained in September, 1899. The work is nine-tenths completed.

The armament has not yet been received.

Money statement.

September 8, 1899, amount allotted	$6,500.00
June 30, 1900, amount expended during fiscal year	4,847.39
July 1, 1900, balance unexpended	1,652.61
July 1, 1900, outstanding liabilities	1,650.00
July 1, 1900, balance available	2.61

Emplacements for two 8-inch B. L. rifles on United States disappearing carriages, model 1896, and two 5-inch rapid-fire guns on balanced-pillar mounts.—Plans for these emplacements were drawn early in 1898, and work was begun on a pile dock in August of the same year. At the beginning of the fiscal year the dock had been completed, plant installed, material collected, and buildings erected. The rapid-fire emplacements had been completed, except mounting of the armament and consolidation of slopes. The 8-inch emplacements were brought up to ceiling level and some interior work had been done.

In the construction of these batteries sand has been obtained on the work; also a limited quantity of aggregate. Crushed stone has been supplied by contract. The mixing of concrete has been done partly by hand and partly by a new machine called the "gravity mixer." The latter is very simple, being a steel chute with staggered pins and deflectors on the sides. Water is introduced through spray pipes. There are no moving parts. The results are encouraging, and the mixer is well suited for a moderately sized work.

During the present year both of the batteries have been completed, slopes have been consolidated, sod placed, and seed sown. An electric-light plant has been installed in the 8-inch emplacements, which also supplies light to the 5-inch rapid-fire battery, and will eventually supply the 5-inch wire-wound battery. The platforms of the 8-inch emplacements have been asphalted, with a view of rendering them waterproof. Cracks in this covering have developed during the winter, and it seems that a slightly softer material will be necessary. The lifts of the 8-inch emplacements have been assembled. Two carriages and one gun of the 8-inch battery are mounted; also the two carriages of the 5-inch rapid-fire battery. One 8-inch rifle and two 5-inch rifles have not yet been received. During the suspension of work the emplacements have been in charge of two watchmen. These batteries are complete and ready for transfer to the artillery.

No garrison is present.

Money statements.

Two 8-inch gun emplacements.

July 1, 1899, balance unexpended	$25,890.62
June 30, 1900, amount expended during fiscal year	25,334.02
July 1, 1900, balance unexpended	556.60
July 1, 1900, outstanding liabilities	34.13
July 1, 1900, balance available	522.47

Two 5-inch rapid-fire gun emplacements.

July 1, 1899, balance unexpended	$6,122.12
June 30, 1900, amount expended during fiscal year	6,122.12

PRESERVATION AND REPAIR OF FORTIFICATIONS.

June 8, 1900, amount allotted	$1,650.00
July 1, 1900, balance available	1,650.00

Abstract of proposals for electric-light plant, opened by Maj. Smith S. Leach, Corps of Engineers, United States Army, September 27, 1899.

No.	Name of bidder.	Price for plant complete.	Date of delivery.
1	Burhorn & Granger, New York, N. Y	$2,000	60 days after date.
2	General Electric Co., Schenectady, N. Y	1,495	Dec. 31, 1899.
3	Walworth Construction and Supply Co., Boston, Mass	1,497	Nov. 18, 1899.
4	McKay Engineering Co., Baltimore, Md	1,784	Nov. 4, 1899.
5	B. O. Ellis, New York, N. Y	[a]1,451	Oct. 30, 1899.
6	New Jersey Foundry and Machine Co., New York, N. Y	1,632	10 weeks from date of order.

[a] Recommended for acceptance.

Contracts in force during the fiscal year.

With B. O. Ellis, of New York, N. Y., for electric-light plant. Contract entered into October 13, 1899; approved November 9, 1899; expiration, October 31, 1899.

Emplacements for two 5-inch rapid-fire wire-wound guns.—On August 31, 1899, an allotment of $14,000 from the appropriation for "Gun and Mortar Batteries" was made for the construction of these emplacements. Materials were procured, and excavation, etc., begun before cold weather set in. The battery is now practically complete, except mounting the armament (not yet received), electric wiring, and sodding of the slopes.

Money statement.

August 31, 1899, amount allotted	$14,000.00
June 30, 1900, amount expended during fiscal year	9,357.54
July 1, 1900, balance unexpended	4,642.46
July 1, 1900, outstanding liabilities	1,972.39
July 1, 1900, balance available	2,670.07

Emplacements for two 8-inch B. L. rifles on barbette carriages (15-inch smooth-bore converted).—At the beginning of the fiscal year the battery was practically complete and the electric-light plant installed. The guns were on hand, and also the converted carriages. During the year the interior floors have been concreted, terreplein graded, and all placed in readiness, except mounting of the carriages and guns. The platforms of this battery will need asphalting to make them waterproof. The electric-light system, trolleys, and doors have been thoroughly placed in order. Two watchmen have been on duty when active operations were suspended.

No garrison is present.

Emplacements for two 5-inch rapid-fire wire-wound guns, with parados.—These emplacements were originally authorized for 5-inch rapid-fire guns on balanced-pillar mounts, but subsequently orders were received to adapt them to the wire-wound guns. The emplacements, with the parados between them, have been constructed in rear of the two 8-inch emplacements reported above, and form with them an inclosed work. Operations began in August, 1898. At the beginning of the fiscal year the concrete of the emplacements and parados was completed, except the platforms and superior slopes. Much work has been required upon the sea wall, which was prosecuted under great difficulties. The site is a bar of gravel and sand about 250 feet wide, 1,200 feet long, and 5 feet above high water. All that was known of its stability at the time work was begun was a deduction, from comparison of surveys, that the bar moved to the westward a few feet annually. This movement has been found to be the resultant of much larger movements, sometimes to the west and sometimes to the east, the westerly movements being a little the larger. Wind tides were found to be much higher than indications predicted. The construction of a sea wall was imperative, and enough had been done at the beginning of the present year to hold the site.

During the fiscal year the emplacements have been completed, except mounting the guns, which are not yet received. The casemates under the parados have been closed up, and can be used as quarters. The electric wiring has been overhauled and the terreplein graded. Platforms have been asphalted.

No garrison is present.

Money statements.

GUN AND MORTAR BATTERIES.

Two 5-inch rapid-fire wire-wound guns.

July 1, 1899, balance unexpended	$9,630.00
June 30, 1900, amount expended during fiscal year	8,373.39
July 1, 1900, balance unexpended	1,256.61
July 1, 1900, outstanding liabilities	622.56
July 1, 1900, balance available	634.05

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$2,195.00
June 8, 1900, amount allotted	1,060.00
	3,255.00
June 30, 1900, amount expended during fiscal year	822.32
July 1, 1900, balance unexpended	2,432.68
July 1, 1900, outstanding liabilities	60.00
July 1, 1900, balance available	2,372.68

Emplacements for two 12-inch B. L. rifles on United States disappearing carriages, model 1897; two 10-inch B. L. rifles on United States disappearing carriages, model 1896, and three 6-inch rapid-fire guns on disappearing mounts.—The 12-inch and 10-inch emplacements: Preliminary work was begun on this battery in December, 1898. At the beginning of the fiscal year a cut was dredged through the beach into a pond, thus forming a sheltered harbor. A breakwater jetty was built to protect the cut, a dock constructed on the shore of the pond, a railroad to the site of the emplacements built and equipped, plant purchased and installed, 16,700 yards of excavation made, and 1,338 cubic yards of concrete placed. Four thousand yards of earth placed in the parados of this battery were obtained from the site of the 6-inch battery. The plant here comprises a radial cableway of 760 feet span, a locomotive, a steam crane, a Cockburn continuous mixer, and some minor machinery. The materials for concrete are placed in measured cars and hoisted on an incline to the mixing platform. The concrete from the mixer drops into tubs, which are run under the cableway and then transported to the desired place on the work. Heavy material is transferred by means of the crane and the cableway.

During the fiscal year the 10-inch emplacements, the power room, and the casemate in rear of the 10-inch emplacements were completed.

Contract for the chain ammunition hoists for this battery has been made. They will be installed in the near future.

The two 10-inch guns and carriages are mounted, and are inclosed in wooden penthouses, covered with galvanized corrugated iron roofing. The penthouse rests on the racer and completely incloses the carriage and gun, except the breech and muzzle, and does not interfere with traversing the gun. It is made in detachable pieces fastened together with hooks and buttons so as to be water-tight and to a great extent dust proof. No piece is larger than can be easily handled by three men. It is thought that a well-drilled squad of six men can assemble each house in thirty minutes. The frame skeleton consists of sills, uprights, plates, and trusses, the sides and roof being paneled. The primary object of these penthouses was to protect the guns from the dirt and dust due to the cableway, but they are also protected from the weather and are thus kept in good condition until a garrison can take care of them.

For the mounting of these guns and carriages a double pair of shears was devised, the legs running on dollies. The shears consist of 12 by 12 inch yellow pine joined at the top by a yoke working as a hinge. The hinged arrangement allows adjustment of the gauge, while the angle of legs in the direction of travel is permanent. A compound-geared winch is attached to the shears.

The four gun emplacements are completely damp-proofed. This operation consists in first forming a layer of waterproofing asphalt cement over all the rooms and about a foot above ceiling level. Two-ply Crescent paper is then laid double, with asphalt between the joints and well seamed together. Then another coat of the cement is given, and finally hot sand is rolled on to give a bond for the concrete to follow. The damp-proofing surfaces are sloped or curved so as to drain into the air spaces. This method of insuring dry rooms has thus far given satisfaction.

The 12-inch emplacements are well advanced. The anchor bolts are set, the concrete is up to platform level, and one parapet is finished. The guns and carriages are on hand and will soon be mounted. The casemates in rear of these emplacements are still to be built.

Two sally ports, one at either end, lead to the terreplein of this 4-gun battery, and a narrow-gauge track runs the whole length of the four emplacements. It is expected that by November 1 the entire battery will be complete, except electric lighting.

In the installation of electric lighting it is intended to use brass lamp boxes and cut-out boxes. These boxes are fitted with heavy cylindrical glass globes. The globes are screwed to the boxes and made water-tight by means of rubber gaskets. The cut-out globes are somewhat smaller than the regular lamp globes, but of the same pattern. They render the inspection of the cut-outs easy at any time. The brass boxes are all tapped for three-fourth inch standard pipe. Where exposed to moisture, brass pipe should be preferred instead of iron conduit.

No garrison is present.

The three 6-inch emplacements: Preliminary work was begun in December, 1898. By the beginning of the fiscal year 4,000 yards of excavation had been made. During the fiscal year the excavation has been completed and the concrete begun and well advanced. One of the emplacements is finished to loading platform, and parapet almost completed, and the other two have the foundation courses laid. The battery will be completed by October 1. The carriages are on hand and will be mounted as soon as practicable. The guns are not yet received.

Contract has been let for furnishing the ammunition hoists for this battery. Power for electric lighting will be obtained from the 10-inch and 12-inch battery.

No garrison is present.

Money statements.

TWO 12-INCH AND TWO 10-INCH GUN EMPLACEMENTS.

July 1, 1899, balance unexpended		$165,055.63
June 30, 1900, amount expended during fiscal year		125,011.61
July 1, 1900, balance unexpended		40,044.02
July 1, 1900, amount covered by contract	$9,703.86	
July 1, 1900, outstanding liabilities	9,222.91	
		18,926.77
July 1, 1900, balance available		21,117.25

THREE 6-INCH GUN EMPLACEMENTS.

July 1, 1899, balance unexpended	$78,000.00
June 30, 1900, amount expended during fiscal year	25,056.52
July 1, 1900, balance unexpended	52,943.48
July 1, 1900, outstanding liabilities	13,260.08
July 1, 1900, balance available	39,683.40

PRESERVATION AND REPAIR OF FORTIFICATIONS.

June 8, 1900, amount allotted	$2,000.00
July 1, 1900, balance available	2,000.00

Abstract of proposals for ammunition hoists and doors received in response to advertisement dated January 17, 1900, and opened February 17, 1900, by Maj. Smith S. Leach, Corps of Engineers, United States Army.

No. of proposal.	Name of bidder.	Lump price for 5 hoists and doors for 6-inch emplacements.		Lump price for 2 hoists and doors for 10-inch emplacements.		Lump price for 2 hoists and doors for 12-inch emplacements.		Date of delivery.
		Price with bronze gears.	Price with gears per plan.	Price with bronze gears.	Price with gears per plan.	Price with bronze gears.	Price with gears per plan.	
1	Exeter Machine Works, Pittston, Pa.	$4,754.00	$4,598.00	$2,138.00	$2,063.00	$2,682.00	$2,596.00	June 30, 1900
2	Burdett-Rowntree Manufacturing Co., Chicago, Ill	11,500.00	11,000.00	5,900.00	5,600.00	6,800.00	6,400.00	May 15, 1900
3	Hoffman Engineering and Constructing Co., Philadelphia, Pa.	5,967.00	5,781.00	3,621.00	3,509.00	3,957.00	3,845.00	
4	The Thos. Laughlin Co., Portland, Me	....	3,420.00	....	2,595.00	....	2,420.00	Do.
5	Greenlie, Wyatt & Co., New York, N. Y.	2,917.00	2,867.00	1,827.00	a1,807.00	1,867.00	a1,847.00	June 30, 1900
6	Robt. S. Bishop New York, N Y.	3,275.00	3,250.00	2,150.00	2,100.00	2,200.00	2,150.00	July 31, 1900
7	Ellicott Machine Co., Baltimore, Md	2,825.00	a2,765.00	2,149.00	2,115.00	1,940.00	1,890.00	June 30, 1900
8	George C. Howard, Philadelphia, Pa	....	5,192.00	....	2,466.00	....	3,194.00	
9	Charles F. Chaney, New London, Conn.	6,029.00	5,865.40	2,275.00	2,200.00	2,850.00	2,745.00	July 1, 1900
10	Arthur Falkenau, Philadelphia, Pa	4,650.00	4,600.00	3,765.00	3,700.00	3,865.00	3,800.00	June 15, 1900

[a] Recommended for acceptance.

Three of the 6-inch and the 10-inch and 12-inch hoists pertain to this work.

Contracts in force during the fiscal year.

With Arthur J. Wellington, Boston, Mass., for furnishing small broken stone; contract entered into February 17, approved March 21; work begun April 1; expiration, November 15. 1899.

With Samuel E. Bouker, New York, N. Y., for furnishing large broken stone; contract entered into February 21, approved March 25; work begun May 1; expiration, November 1, 1899.

With Greenlie, Wyatt & Co., New York, N. Y., for furnishing two 10-inch and two 12-inch ammunition hoists and doors; contract entered into March 7, approved March 19; expiration, June 30, 1900.

With Ellicott Machine Company, Baltimore, Md., for furnishing three 6-inch ammunition hoists and doors; contract entered into March 7, approved March 20; expiration, June 30, 1900.

Preservation and repair of fortifications.—During the past year an electrician has been employed in keeping in repair the several electrical plants pertaining to the batteries. On June 7, 1900, an allotment from the appropriation for supplies for coast defenses was made, to be applied to furnishing materials and repairing electric installations.

Money statements.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

For electrician.

July 1, 1899, balance unexpended	$300.00
June 30, 1900, amount expended during fiscal year	300.00

Civilian electrician.

July 1, 1899, balance unexpended	$900.00
June 30, 1900, amount expended during fiscal year	675.00
July 1, 1900, balance available	225.00

TRANSPORTATION OF ARMAMENT.

July 1, 1899, balance unexpended	$320.00
June 30, 1900, amount expended during fiscal year	320.00

SUPPLIES FOR COAST DEFENSES.

June 7, 1900, amount allotted	$800.00
July 1, 1900, balance available	800.00

Submarine mines.—The mining material for the New London and New Haven harbors is stored in casemates at one of the forts. No active operations were conducted during the year. A mining casemate has been completed and partition walls placed to separate battery from the instrument room. The mining material has recently been overhauled and placed in good condition. The balance of material needed for the complete project has not yet been received from the depot.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 21, 1899, amount allotted:	
Act of June 6, 1896	$397.49
Act of March 3, 1897	86.94
Act of May 7, 1898	15.57
	500.00
June 30, 1900, amount expended during fiscal year	322.21
July 1, 1900, balance unexpended	177.79
July 1, 1900, outstanding liabilities	177.79

Purchase of sites for fortifications.—During the year an allotment of $50 was made to pay for services in making abstracts of title to land ready acquired.

Money statement.

March 21, 1900, amount allotted	$50.00
June 30, 1900, amount expended during fiscal year	50.00

Approximate value of plant belonging to the United States and used upon the construction of fortifications under the appropriation for gun and mortar batteries.

Class of property.	Approximate value June 30, 1900.
Hoisting and conveying machinery	$3,885
Railroad plant	1,950
Tools, appliances, etc	800
Cement tester, concrete mixer, etc	225
Office furniture	100
Surveying instruments	105
Typewriter	50
Drawing instruments	15
Steam lighter Panuco	7,000
Total	14,130

Approximate value of plant belonging to the United States and used at Fort Trumbull, Conn.

Class of property.	Approximate value June 30, 1900.
Derricks	$25
Office furniture	10
Total	35

Approximate value of plant belonging to the United States and used upon the construction of fortifications under the appropriation for "National Defense," act of March 9, 1898.

Class of property.	Approximate value June 30, 1900.
Tools and appliances	$175
Boilers, engines, and pumps	1,800
Railroad plant	1,050
Concrete mixer, etc	550
Outfit for quarters	40
Total	3,615

3 F.

DEFENSES OF NEW YORK HARBOR.

Officers in charge of artillery defense and of torpedo defense of southern entrance to harbor, Maj. Henry M. Adams, Corps of Engineers, to November 16, 1899; the late Lieut. Col. William H. H. Benyaurd, Corps of Engineers, from November 16, 1899, to January 8, 1900; Maj. William L. Marshall, Corps of Engineers, since January 8, 1900; assistants, Lieut. James F. McIndoe, Corps of Engineers, Lieut. Jay J. Morrow, Corps of Engineers, to August 27, 1899, and Lieut. James A. Woodruff, Corps of Engineers. Officer in charge of torpedo defense of eastern entrance to harbor, Maj. John G. D. Knight, Corps of Engineers. Division Engineer, Col. George L. Gillespie, Corps of Engineers.

AT EASTERN ENTRANCE TO HARBOR.

Mortar battery for sixteen 12-inch mortars.—At the beginning of the fiscal year the mortar battery had been completed, mortars mounted, and the battery lighted by electricity; work of altering the platforms for new-type azimuth circles was in progress. An earthen parapet and temporary magazines had been constructed for the practice battery, where one 8-inch B. L. rifle on altered 15-inch carriage and one 8-inch converted rifle were mounted.

During the past fiscal year the following work was done: The new azimuth circles were delivered in August, 1899, and were set; the floors of the pits were regraded, to improve drainage.

Two emplacements for 5-inch rapid-fire guns.—Work was begun August 7, 1899, under allotments of $20,000, made July 25 and August 9, 1899. At the close of the fiscal year the emplacements were nearly completed, about 75 cubic yards of concrete and some paving and earth embankment being yet required. The magazines were covered with an asphalt waterproof course, consisting of three layers of rock asphalt laid as thin as it could be spread while hot, with a layer of heavy roofing paper between each two layers of asphalt; the thickness of the whole averaged slightly over three-fourths of an inch. The cost was $1.23 per square yard for 177 square yards. The emplacements contain 1,372 cubic yards of concrete, laid at a cost of $8.25 per yard. The excessive cost is nearly all due to transportation of material, the site being distant from the landing, and the amount of work being insufficient to warrant building a landing near the site.

Preservation and repair of fortifications.—Work during the fiscal year at the site of the mortar and 5-inch batteries consisted in the construction of storm doors for mortar battery, in waterproofing ceiling of dynamo room of electric plant, and in making minor repairs where needed, under allotments made for the purpose.

Armament: No changes were made during the year in the armament of the above emplacements.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$5,358.54
June 30, 1900, amount allotted during fiscal year		20,000.00
		25,358.54
June 30, 1900, amount expended during fiscal year	$15,687.67	
June 30, 1900, amount deposited and withdrawn during fiscal year	4,251.22	
		19,938.89
July 1, 1900, balance unexpended		5,419.65
July 1, 1900, outstanding liabilities		1,987.50
July 1, 1900, balance available		3,432.15

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended		$1,187.99
June 30, 1900, amount allotted during fiscal year		284.80
		1,472.79
June 30, 1900, amount expended during fiscal year	$90.88	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	1,157.99	
		1,248.87
July 1, 1900, balance unexpended and available		223.92

On the northern side of eastern entrance.—These works consist of an old stone fort and outlying batteries, with modern batteries.

At the beginning of the fiscal year, July 1, 1899, the battery of two 10-inch guns had been completed and armed; one 12-inch emplacement had been completed and armed, and of the second 12-inch emplacement the concrete work was nearly finished and work on embankment was in progress; two emplacements for 5-inch rapid-fire guns have been completed as far as possible until carriages are delivered; two emplacements for 15-pounder rapid-fire guns had been begun, concrete construction being built up to magazine ceilings; an electric-lighting plant had been installed in one of the casemates of the stone fort; cables had been laid, and electric lights set in the completed emplacements, and a searchlight had been mounted and connected.

During the past fiscal year the following work has been done:

One emplacement for 12-inch gun (No. 2): The concrete work and embankment were completed, machinery for handling ammunition was installed, and electric lights were set. This emplacement is completed except a small part of sodding; its gun and carriage are mounted.

Two emplacements for 5-inch rapid-fire guns: The carriages were received, base rings set, and paving of platform completed; the rear roadway was graded and covered with stone. The guns are not yet received.

Two emplacements for 15-pounder rapid-fire guns: 184 cubic yards of concrete were laid and 2,040 cubic yards of embankment built; the emplacements are completed. Guns not mounted.

Electric-lighting plant: Conduits were laid and carried from the dynamo to 12-inch emplacement No. 2; searchlights were set up and covered with a shelter. Under allotment of $3,000, made May 29, 1900, the parts of the searchlights proper now at this post are to be reassembled, and when completed are to be sent to one of the service schools.

Range-finder stations: Authority was granted for the construction of two range-finder stations, type A, one for the 12-inch and one for the 10-inch emplacements. These stations consist of square concrete towers with iron roofs and stairways, and earth embankment on the exposed sides. They were completed during the fiscal year.

The construction of an iron gallery to connect platforms of 10-inch battery was authorized May 8, 1900; no work has yet been done.

Preservation and repair of fortifications: An allotment of $200 was made to be applied to construction of a shelter for searchlight outfit and to alterations to one already built. Work was begun in March, 1900, but was suspended under orders from the Chief of Engineers.

Work of correcting leakage in the two 10-inch emplacements and the first 12-inch emplacement was authorized under allotment of $700; during the month of June a waterproof coat was applied to 12-inch emplacement No. 1.

A ventilator and partition were built in dynamo room.

Minor repairs were made where necessary.

Riprap shore protection: An allotment of $2,400 was made from the appropriation for "Sea Walls and Embankments," for protecting the north shore from erosion by storms; the earth washed away has been replaced, and 1,240 cubic yards of rubblestone have been placed along shore for a distance of about 500 feet, in line with the wall already built. The allotment has not yet been wholly expended.

Construction of sea wall: An allotment of $10,000 was made June 27, 1900, to be applied to the construction of a sea wall on the north shore of the reservation in accordance with the project of expenditure submitted June 19, 1900; work has not yet been begun.

Armament: One 12-inch gun on disappearing carriage mounted in emplacement No. 2.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$44,587.68
June 30, 1900, amount expended during fiscal year	$27,350.94	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	1,927.82	
		29,278.76
July 1, 1900, balance unexpended		15,308.92
July 1, 1900, outstanding liabilities		418.69
July 1, 1900, balance available		14,890.23

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$616.04
June 30, 1900, amount allotted during fiscal year	1,510.00
	2,126.04
June 30, 1900, amount expended during fiscal year	553.47
July 1, 1900, balance unexpended	1,572.57
July 1, 1900, outstanding liabilities	234.94
July 1, 1900, balance available	1,337.63

SEA WALLS AND EMBANKMENTS.

July 1, 1899, balance unexpended	$2,400.00
June 30, 1900, amount allotted during fiscal year	10,000.00
	12,400.00
June 30, 1900, amount expended during fiscal year	1,226.95
July 1, 1900, balance available	11,173.05

On southern side of eastern entrance.—These fortifications consist of an old casemated stone fort with old batteries and modern defenses.

At the beginning of the fiscal year, July 1, 1899, four emplacements of the gun battery (six positions for disappearing guns, two 8-inch, two 10-inch, and two 12-inch) were completed and armed, emplacements Nos. 4 and 5, for 12-inch guns, being under construction, with the concrete work nearly finished; two emplacements for 5-inch rapid-fire guns were completed, except grading and electric wiring; two emplacements for 15-pounder rapid-fire guns had been begun, and a battery containing eight positions for 12-inch B. L. mortars had been completed.

During the past fiscal year the following work was done:

Disappearing gun battery: Emplacements Nos. 4 and 5, for 12-inch guns: The concrete work was finished; machinery for handling ammunition was installed; the emplacements were wired for electric lighting and are very nearly completed; guns are mounted.

Emplacement No. 6, for 8-inch gun: The rear roadway was graded and side banks sodded.

Two emplacements for 5-inch rapid-fire guns: The slopes were graded and sodded, the roadway was macadamized, and electric wiring placed. Carriages have been received, but not mounted.

Two emplacements for 15-pounder rapid-fire guns: These emplacements were completed and are armed. During the year 767 cubic yards of earth were excavated, 602 cubic yards of concrete placed, and 111 square yards of asphalt waterproofing course were laid. The location being wet, especial care was taken to prevent dampness in the magazines. An asphalt course was laid in the floors and another over the magazines, extending past the air spaces which were built around three sides of the rooms; hollow bricks were laid on the outer side of the earth-covered walls. The asphalt course was laid one-half inch thick, at a cost of 28 cents per square yard. So far the rooms have kept dry. This course consisted of 16 parts of rock asphalt to 1 part of bitumen, melted together, laid hot and ironed. The hollow brick were of ordinary size, laid one thickness as a wall over the faces of the concrete walls near the magazines.

Electric-lighting plant: This plant is in course of construction in the old storage casemates in rear of the disappearing gun battery. A horizontal, double-acting, automatic cut-off engine, direct connected, has been set up, with a 55-horsepower water-tube boiler. Steam and water connections have been partly made.

The disappearing-gun battery and the two 5-inch rapid-fire gun emplacements have been wired and lamps placed; the lamps are 16 candlepower, 114 fixed lamps in magazines, passages, etc., and 8 portable ones at the platforms.

A type "G 13," 62-cell storage battery has been ordered, but not yet received.

Electric underground conduits: A 4-duct vitrified conduit has been laid in rear of the disappearing-gun battery and of the 5-inch rapid-fire emplacements, with manholes opposite the power house and each emplacement, and with branch conduits to the several emplacements. Lead-covered cables are used in these conduits.

Torpedoes for harbor defense: A mining casemate, completed in May, 1899, was turned over to the commanding officer June 8, 1899.

Preservation and repair of fortifications: The asphalt waterproof covering, placed over emplacements Nos, 1, 2, and 3, and part of No. 4, disappearing-gun battery, during the previous year, proved defective and was replaced by the contractors at their own expense. The magazines have since been fairly free from dampness.

The traverse rail of emplacement No. 3 disappearing-gun battery was releveled, and a washout on the slope of the same emplacement was repaired.

Armament: Two 12-inch B. L. rifles mounted in emplacements Nos. 4 and 5, disappearing-gun battery; two 15-pounder rapid-fire guns mounted in the completed emplacements for same.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$56,990.97
June 30, 1900, amount allotted during fiscal year		6,325.00
		63,315.97
June 30, 1900, amount expended during fiscal year	$49,796.10	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	392.25	
		50,188.35
July 1, 1900, balance unexpended		13,127.62
July 1, 1900, outstanding liabilities		5,165.12
July 1, 1900, balance available		7,962.50

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended		$652.00
June 30, 1900, amount allotted during fiscal year		900.00
		1,552.00
June 30, 1900, amount expended during fiscal year	$413.23	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	189.19	
		602.42
July 1, 1900, balance unexpended		949.58
July 1, 1900, outstanding liabilities		9.00
July 1, 1900, balance available		940.58

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended		$1,036.31
June 30, 1900, amount expended during fiscal year	$261.50	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	774.81	
		1,036.31

Torpedo defenses at eastern entrance to New York Harbor.—A complete list has been prepared, showing all materials needed for the approved project of defense.

The casemate and part of the materials on hand are utilized in the instruction of officers and enlisted men of the Battalion of Engineers.

No funds have been expended for these defenses during the year.

AT SOUTHERN ENTRANCE TO HARBOR.

Fort Columbus, Castle Williams, and South Battery.—No modern works of defense are at this point.

The only work done during the past fiscal year was the renewing of the timber work on the drawbridge at the main entrance to Fort Columbus and repair of stone abutments under allotment from the appropriation for "Preservation and Repair of Fortifications."

Sea wall at Governors Island, New York Harbor.—This wall, completed in 1893, incloses the entire island. It is in good repair and no work upon it is required at present.

Money statement.

July 17, 1899, amount allotted		$325.00
June 30, 1900, amount expended during fiscal year	$271.24	
Amount deposited with assistant treasurer	53.76	
		325.00

Fort Lafayette, New York.—This work is situated on Hendricks Shoal, in the Narrows, New York Harbor, about 1,000 feet from the Long Island shore. The area inclosed by a sea wall is about 270 feet square.

The fort is a circular casemated structure in three tiers, built of Newark red sandstone founded on riprap. It was injured by fire in 1868, since which time it has been abandoned as a work of defense.

No work has been done during the past fiscal year.

Defenses on Long Island.—These fortifications consist of an old casemated stone fort and outlying batteries, with modern batteries.

At the beginning of the fiscal year, July 1, 1899, a battery of seven emplacements for 10-inch guns had been completed, all the carriages and five of the guns being mounted; two emplacements for 4.7-inch rapid-fire guns had been completed and guns mounted; emplacements Nos. 1 and 2 of a battery of four emplacements for 12-inch guns had been completed but not armed; emplacements Nos. 3 and 4 were under construction; at the mortar battery, eight positions for 12-inch mortars, excavation was partly completed; two emplacements for 15-pounder rapid-fire guns had been begun; two emplacements for 12-inch guns and two for 6-inch guns on the old stone fort, and two armored shelters for battery commanders' stations had been authorized but not begun.

During the past fiscal year the following work has been done:

Seven-gun battery: The two remaining guns were mounted; iron galleries connecting adjacent loading platforms have been built; regrading and sodding the front slopes has been in progress and is nearly completed. Authority was granted by the Chief of Engineers to widen the roadway and to build a retaining wall at this battery; work has not been begun.

Battery of four 12-inch guns: The concrete work of this battery was completed, 7,489 cubic yards of masonry being placed; 8,221 cubic yards of earth and 3,105 square yards of sod were excavated for parapet and slopes; ammunition hoists were placed, water-supply pipes and electric conduits were laid. The battery is very nearly completed. Guns are mounted in emplacements Nos. 1 and 2 and carriages without guns in emplacements Nos. 3 and 4. Under allotment of $500, the delivery tables of the two 12-inch nondisappearing emplacements are to be raised to adapt them to ammunition trucks issued by the Ordnance Department.

Mortar battery for eight 12-inch B. L. mortars: Eight thousand five hundred and sixty-two cubic yards of concrete and masonry were laid, nearly completing the concrete work; 5,779 cubic yards of earth were removed and 1,000 square yards of sod laid in building the parapets and slopes, which are not yet finished. The base rings for the platforms are set.

Two emplacements for 15-pounder rapid-fire guns: Six hundred and fifty-nine cubic yards of masonry have been built, 532 cubic yards of earth excavated, and 400 yards placed in the parapets and slopes, 703 square yards of which have been sodded. This work is nearly completed; it is ready for armament.

Two emplacements for 12-inch guns in stone fort: This work required the removal of parts of the masonry of the old fort; 5,998 cubic yards of this masonry were removed; 3,712 cubic yards of material excavated for foundations; 2,748 cubic yards of concrete masonry were placed and ceiling beams set over the rooms and passages; the concrete cover in front of the air spaces is built up to 4 feet below the superior slope.

Two emplacements for 6-inch guns on disappearing carriages in stone fort: Three thousand six hundred and four cubic yards of old masonry were removed, 2,121 cubic yards of material were excavated for foundations, and 1,041 cubic yards of material were removed for parapet. The site has been made ready for concrete construction.

Two battery commanders' stations: These stations consist of masonry buildings and foundations with steel roofs. They were completed during the fiscal year and turned over to the commanding officer.

Installation of an electric tide indicator for use in battery commanders' stations: This work was authorized March 13, 1900, and an allotment of $1,000 made for that purpose. Necessary materials have been ordered and partly received.

The following table gives the amounts and unit cost of the principal items in the chief works of construction:

	12-inch battery in stone fort.	6-inch battery in stone fort.	Mortar battery.	Battery of four 12-inch guns.
Demolition of masonry:				
Number of cubic yards	5,998	3,604	....	....
Cost per cubic yard	$0.70	$0.54	....	....
Excavation for foundations:				
Number of cubic yards	3,712	2,121	9,375	....
Cost per cubic yard	$0.60	$0.62	$0.44	....
Concrete:				
Number of cubic yards	*a*2,748	....	*b*8,562	*c*7,489
Cost per cubic yard	$4.70	....	$5.76	$4.13
Grading parapets and slopes:				
Number of cubic yards	1,257	1,040	5,779	8,221
Cost per cubic yard	$0.48	$0.52	$0.44	$0.33
Sodding:				
Number of square yards	....	....	1,000	3,105
Cost per square yard	....	....	$0.40	$0.27

Cost of concrete includes cost of materials, hauling, mixing, and placing, cost of finishing and setting up forms, and cost of asphalt waterproofing course one-half inch thick.

a 2,649 cubic yards Rosendale cement concrete and 99 cubic yards random stone.

b 8,307 cubic yards Portland cement concrete, 50 cubic yards brick masonry (for doors and corners), 205 cubic yards granolithic finish.

c 104 cubic yards Rosendale cement concrete, 6,853 cubic yards Portland cement concrete, 35 cubic yards brick masonry, and 497 cubic yards pavement.

Preservation and repair of fortifications: Under several allotments minor repairs have been made upon cranes, hoists, doors, hand rails, pavement, drainage, and ventilation in the battery for seven 10-inch guns; repairs have also been made to the electric-lighting plant, to ditch and exterior slopes, and to the sea wall. A searchlight shelter has been built.

Armament: Two 10-inch guns on disappearing carriages mounted in emplacements 1 and 2 of the battery for seven 10-inch guns; two 12-inch guns mounted in emplacements 1 and 2 of the battery for four 12-inch guns; one additional 12-inch gun is being mounted in emplacement 3 of that battery.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$343,313.71
June 30, 1900, allotted during fiscal year		4,250.00
		347,563.71
June 30, 1900, amount expended during fiscal year		173,673.13
July 1, 1900, balance unexpended		173,890.58
July 1, 1900, outstanding liabilities	$19,323.58	
July 1, 1900, amount covered by existing contracts at end of fiscal year	40,947.05	
		60,270.63
July 1, 1900, balance available		113,619.95

PRESERVATION AND REPAIR OF FORTIFICATIONS.

June 30, 1899, balance unexpended	$2,903.61
June 30, 1900, allotted during fiscal year	1,700.00
	4,603.61
June 30, 1900, amount expended during fiscal year	1,514.58
July 1, 1900, balance unexpended	3,089.03
July 1, 1900, outstanding liabilities	613.88
July 1, 1900, balance available	2,475.15

NATIONAL DEFENSE.

Gun and mortar batteries.

July 1, 1899, balance unexpended		$1,951.17
June 30, 1900, amount expended during fiscal year	$1,931.93	
June 30, 1900, amount deposited to credit of appropriation	19.24	
		1,951.17

Abstract of proposals for cement, broken stone, and sand received in response to advertisement of February 13, 1900, and opened March 15, 1900, by Maj. W. L. Marshall, Corps of Engineers, United States Army, New York City, N. Y.

No. of bid.	Name of bidder.	20,000 barrels Portland cement.				
		Brand.	Per barrel.	Per barrel in sacks.	Rebate per sack returned.	Total bid.
					Cents.	
2	Manhattan Supply Co. *a*	Star	$2.17	$2.34	10	$43,400
			1.94			38,800
10	Hiram Snyder & Co	Alpha or Lehigh	2.11	2.35	10	42,200
			1.95			39,000
13	Atlas Portland Cement Co. *b*	Atlas	2.14	*c* 2.34	*c* 10	42,800
			1.95			39,000
15	Sparrow, Friedenberg & Co	Imported Hemmoor	1.947			38,940

No. of bid.	Name of bidder.	16,000 cubic yards broken stone.			8,000 cubic yards sand.		
		Kind.	Per cubic yard.	Total bid.	Kind.	Per cubic yard.	Total bid.
						Cents.	
1	Phœnix Towing and Transportation Co.				Hempstead Harbor.	*c* 33⅔	*d* $2,693.33
3	Jacob E. Conklin	Trap	$1.50	$24,000			
4	John J. Donovan *e*	Granite.	1.57	25,120			
5	Metropolitan Crushed Stone Co. *f*	Trap	.95	15,200			
6	Joseph D. Kidder *g*	Trap	1.05	16,800			
7	John S. Lane & Son	Trap	.87	13,920			
8	Manhattan Trap Rock Co	Trap	.75	12,000			
9	Harry Goodwin				Cow Bay	34	2,720.00
11	E. F. Rendt *h*				West End, N. J	49¾	3,980.00
12	William Reinhardt *i*				Hempstead Harbor.	47	3,760.00
14	John D. Miller	Trap	.75	12,000			

All proposals for broken stone were rejected because none of the samples submitted meets with the requirements of the specifications.

a Tie bid with No. 13 for cement in sacks.
b Tie bid with No. 2 for cement in sacks. Recommended for acceptance.
c Accepted.
d Lowest bid for sand.
e Informal; paragraph 6 of specifications not complied with.
f Informal; paragraph 10 of specifications not complied with; evidence of authority for signature not submitted.
g Guaranty accompanying proposal not dated.
h Informal; only one bid submitted; neither certificate nor guaranty given.
i Informal; paragraph 8 of specifications not complied with.

Contracts in force.

With the Atlas Cement Company, for American Portland cement, Atlas brand; dated March 24, 1899; approved by the Chief of Engineers April 18, 1899; approximate amount, 25,000 barrels, at $1.99 per barrel; to be completed in accordance with specifications.

With Jacob E. Conklin, for broken trap rock; contract dated April 1, 1899; approved by the Chief of Engineers April 21, 1899; approximate amount, 21,000 cubic yards, at 84 cents per cubic yard; to be completed in accordance with specifications. Contract completed.

With Harry Goodwin, for sand; contract dated March 30, 1899; approved by the Chief of Engineers April 12, 1899; approximate amount, 11,000 cubic yards, at 34 cents per cubic yard; to be completed in accordance with specifications. Contract completed.

With the Atlas Portland Cement Company, for American Portland cement, Atlas brand; contract dated April 6, 1900; approved by the Chief of Engineers May 3, 1900; approximate amount, 20,000 barrels, at $2.34 per barrel, delivered in sacks, 4 sacks to the barrel, allowing 10 cents for each empty sack returned; to be completed in accordance with specifications.

With the Phœnix Towing and Transportation Company, for sand; contract dated March 27, 1900; approved by the Chief of Engineers April 17, 1900; approximate amount, 8,000 cubic yards, at 33⅓ cents per cubic yard; to be completed in accordance with specifications.

Defenses on Staten Island.—These fortifications consist of two old casemate stone forts and outlying batteries with modern defenses.

At the beginning of the fiscal year a mining casemate, torpedo storage building, and three cable tanks were constructed and equipped with machinery for handling material; the following batteries and emplacements had been completed and armed: A 5-gun battery for 8-inch rifles; two batteries, each for two 10-inch rifles, with electric-lighting plant and range-finder shelters; two emplacements for 6-inch rapid-fire guns; two emplacements for 4.7-inch rapid-fire guns; two emplacements for 8-inch B. L. rifles on modified 15-inch gun carriages.

A battery for two 12-inch guns on disappearing carriages was completed, but not armed; electric plant was installed.

Two emplacements for 15-pounder rapid-fire guns were completed.

A second battery of two emplacements for 12-inch guns was under construction; platforms were completed and magazines built up to ceiling level.

Two emplacements for 6-inch guns on disappearing carriages were under way, emplacement No. 2 being nearly completed.

During the past fiscal year the following work has been done:

Two emplacements for 12-inch guns: These have been completed, except a small amount of sodding on the superior slope and construction of a short sea wall at the foot of the left flank of the exterior slope. Armament is now being mounted.

Two emplacements for 6-inch guns on disappearing carriages: These have been nearly completed; there remains a small amount of parapet construction.

An underground electric conduit system has been laid, connecting all the emplacements, the power houses, and the battery commander's and fire commander's stations. The conduits are of vitrified clay, 4-duct for the main line and 2-duct for the branches.

Reassembling portable searchlight outfits: Under authority of the Secretary of War and allotment of May 29, 1900, two 4–10–450 General Electric direct-connected sets are to be purchased and mounted upon platform trucks pertaining to the generating sets now installed, and when completed these sets, with others, are to be sent to the four service schools.

Concrete was mixed in a revolving cubical mixer, except that, in the 6-inch emplacements in addition to machine mixing, 809 cubic yards were mixed by hand; the cost was found to be greater by 56 cents per cubic yards. The materials used were Portland cement, Alpha brand, broken trap rock, and beach sand obtained on the reservation at the cost of hauling. The proportions used were 1 of cement, 3 of sand, and 5 of broken stone. The floors and upper surfaces of concrete work were covered with a pavement of 1 part of Portland cement, 3 parts of sand, 5 parts of broken stone, laid 6 inches thick, with surface 2 inches, 1 part cement to 3 of sand.

The following table gives an accurate compilation of the cost of principal items of work:

Cost of concrete construction, etc., July 1, 1899, to June 30, 1900.

	Two 12-inch emplacements.	Two 6-inch emplacements.
Number of cubic yards of concrete	5,609	a 3,778
Proportion of materials in concrete: Portland cement, broken stone, sand	1 : 3 : 5	1 : 3 : 5
Cost of materials:		
Portland cement, per barrel	$1.98	$1.98
Broken stone, per cubic yard	.81	.81
Sand, hauled from beach, hauling per cubic yard	.175	.20
Concrete in place: cost per cubic yard of concrete:		
Cement, at $1.98 per barrel	2.546	2.546
Broken stone, at $0.81 per cubic yard	1.041	1.041
Sand, at $0.175 and $0.20 per cubic yard	.225	.257
Receiving and storing materials, at $0.116 and $0.084 per cubic yard and barrel.	.149	.180
Mixing, placing, and ramming	.879	1.110
Forms, lumber, and labor	.477	.950
Superintendence and miscellaneous items	.190	.150
Total cost per cubic yard	5.507	6.234
Concrete pavement, 8 inches thick (1,044 square yards):		
Proportion of materials—		
Body of concrete	1 : 3 : 5	1 : 3 : 5
2-inch depth of mortar	1 : 8	1 : 3
Cost per square yard—		
Materials	$0.660	$0.680
Labor	1.030	1.050
Total cost per square yard	1.690	1.730
Asphalt waterproofing course, one-half inch thick:		
Cost per square yard—		
Materials	.280	.630
Labor	.205	.290
Total cost per square yard	.485	.920
Sodding, materials obtained from reservation (14,678 square yards):		
Cost of cutting and hauling, per square yard, by contract	.085	.085
Cost of laying, per square yard	.080	.080
Total cost per square yard	.165	.165
Cost of earth excavation, per cubic yard	.354	.310

a Eight hundred and nine cubic yards of concrete, included above, were mixed by hand at an additional cost, over cost of machine-mixing, of $0.56 per cubic yard.

Cost of electric conduit system.

Linear feet laid	5,311
Cost of excavation and covering, per linear foot	$0.102
Cost of laying and wiring conduits, per linear foot	.038
Cost of 4-duct conduit (material only), per linear foot	.280
Cost of 2-duct conduit (material only), per linear foot	.140
Total cost of 4-duct conduit, in place, per linear foot	.420
Total cost of 2-duct conduit, in place, per linear foot	.280

Preservation and repair of fortifications: Work during the fiscal year consisted in repairs to ammunition lift of one of the 10-inch batteries and of slopes of batteries damaged during the winter. The concrete of one of the 12-inch batteries, damaged by the garrison while mounting guns, was repaired; two hydrants, with water connections, were placed in rear of that battery. A tile gutter was laid on slope of emplacement No. 1 of one of the 10-inch batteries.

The submarine mining material was cleaned, repaired, and covered with prescribed composition.

One drum multiple cable was removed from the small to the large cable tank.

Fifty-six 43-inch mine cases and eight 48-inch mine cases were shipped to Seattle, Wash., and Yerba Buena Island, Cal.

Sites for fortifications and seacoast defenses: Condemnation proceedings have been instituted for the acquisition of two properties. An allotment of $50,000 has been made for this purpose, November 24, 1899. The matter is in the hands of the United States attorney for the eastern district of New York.

An allotment of $45,000 has been made June 19, 1900, for the purchase of a third tract, offered by the present owner to the United States at the appraised valuation. Search of title is in progress.

Armament: Two 12-inch guns on disappearing carriages were mounted.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$88,259.04
Allotted since		3,350.00
		91,609.04
June 30, 1900, amount expended during fiscal year	$85,583.89	
Amount deposited to credit of appropriation	747.50	
		86,331.39
July 1, 1900, balance unexpended		5,277.65
July 1, 1900, outstanding liabilities		1,602.94
July 1, 1900, balance available		3,674.71

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended	$449.29
June 30, 1900, amount expended during fiscal year	449.29

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

June 30, 1900, allotments since beginning of fiscal year	$95,000.00
June 30, 1900, balance unexpended	95,000.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$585.40
Allotted since	2,814.00
	3,399.40
June 30, 1900, amount expended during fiscal year	1,803.57
July 1, 1900, balance unexpended	1,595.83
July 1, 1900, outstanding liabilities	265.30
July 1, 1900, balance available	1,330.53

NATIONAL DEFENSE.

Gun and mortar batteries.

July 1, 1899, balance unexpended		$238.54
June 30, 1900, amount expended during fiscal year	$230.58	
June 30, 1900, amount deposited to credit of appropriation	7.96	
		238.54

Torpedo defense, Narrows, New York Harbor.

July 1, 1899, balance unexpended	$43.14
June 30, 1900, amount expended during fiscal year	43.14

Defenses at Sandy Hook.—This fortification, on the south side of the main entrance to New York Harbor, consists of an old casemated stone fort with modern batteries.

At the beginning of the fiscal year a mining casemate, a storage building, and four cable tanks were built; mortar battery for sixteen 12-inch B. L. mortars was completed, eight of the mortars being provided with index rings of new pattern and the other eight being in process of alteration; gun-lift battery No. 1, for two 12-inch guns, was completed and guns were mounted, and three Gatling guns had been mounted for gorge defense. Battery of two positions for 10-inch guns was completed and guns mounted; battery of three positions for 10-inch guns and four for 12-inch guns was nearly completed, the 10-inch emplacements being armed and the armament for the 12-inch emplacements being ready to mount; one emplacement for 5-inch rapid-fire gun was completed and gun mounted; the pneumatic dynamite gun battery, containing three positions for dynamite guns, one 8-inch and two 15-inch, was completed with temporary parapet and magazines, and guns were mounted; temporary emplacements for one 5-inch siege rifle, one 7-inch siege howitzer, and one 4.7-inch rapid-fire gun were built and guns mounted; two emplacements for 15-pounder rapid-fire guns had been built as far as practicable, awaiting delivery of the mounts; a range-finder tower had been built; two independent searchlight plants had been installed.

The following work was done during the fiscal year:

Mortar battery: The remaining eight mortars were provided with index rings of new pattern, completing the alterations for the battery.

Battery of three 10-inch and four 12-inch guns: This battery is nearly completed. The final completion of the sand parapet and removal of obstructing masonry from the field of fire will interfere with the present operations at the Sandy Hook Proving Ground, and has therefore been deferred. Part of the exposed concrete was treated with Sylvester waterproofing process.

Four 12-inch guns were mounted during the year and the battery is now fully armed.

Five-inch rapid-fire gun emplacement: The gun platform was cut out and relaid to correspond to changes in the mount adopted by the Ordnance Department.

Two 15-pounder rapid-fire gun emplacements: Final completion is delayed pending arrival of the mounts. Sand, which had blown in upon the emplacements during the winter, was removed and the slopes were protected with brushwood and ashes.

Pneumatic dynamite gun battery: Work upon construction of concrete retaining walls and bombproofs has been begun, under allotment made June 12, 1900.

Two additional emplacements for 15-pounder rapid-fire guns: Allotment for construction was made June 13, 1900; work has been begun.

Range-finder tower: The fitting up of the instrument room was completed and the keys turned over to the commanding officer.

Plank roadways: Three thousand seven hundred feet of roadways 8 feet wide were built, connecting the mortar battery, battery of two 10-inch guns, and the first 15-pounder gun battery with the existing roads.

Reassembling portable searchlight outfits: Under allotment of $3,000, made May 29, 1900, the parts of the searchlights proper are to be reassembled and two 4–10–450 General Electric direct-connected sets are to be purchased and mounted upon platform trucks pertaining to the generating sets now installed, and when reassembled these sets, together with two other sets, are to be shipped to the four service schools.

Preservation and repair of fortifications: The following work has been done during the fiscal year:

At the gun-lift battery an engineman has been employed and the mechanism kept in good condition.

At battery for three 10-inch and four 12-inch guns 836 square yards of Rosendale cement pavement over the magazines of the 10-inch emplacements were removed to 1 foot depth and replaced with Portland cement pavement. Minor repairs were made to the electric wiring.

At the mortar battery the interior sand slopes, which were too steep to stand the firing of the mortars, were regraded to a slope of 1 upon 2, and the sod relaid.

Submarine mining materials: The stored cable was overhauled and examined; the oil engine was removed from the mining casemate and stored in the torpedo-storage building; repairs to instruments were made.

Miscellaneous: Small repairs were made to the revetment of the pneumatic-gun battery; the battery commander's station in battery for two 10-inch guns was closed up, drains were laid, doors painted, and property cared for.

Sea walls and embankments: The sea walls are completed; nothing was done during the fiscal year.

Armament: Four 12-inch B. L. rifles were mounted; the 5-inch siege rifle and 7-inch siege howitzer, temporarily mounted for cover of mine fields, were dismounted and removed.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$9,972.64
June 30, 1900, amount allotted since		39,800.00
		49,772.64
June 30, 1900, amount expended during fiscal year	$8,278.55	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	2,189.35	
		10,467.90
July 1, 1900, balance unexpended		39,304.74
July 1, 1900, outstanding liabilities		1,065.84
July 1, 1900, balance available		38,238.90

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended		$10,173.10
June 30, 1900, amount allotted during fiscal year		4,546.79
		14,719.89
June 30, 1900, amount expended during fiscal year	$11,429.86	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	443.75	
		11,873.61
July 1, 1900, balance unexpended		2,846.28
July 1, 1900, outstanding liabilities		623.92
July 1, 1900, balance available		2,222.36

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended		$258.19
June 30, 1900, amount expended during fiscal year	$249.64	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	8.55	
		258.19

SEA WALLS AND EMBANKMENTS.

Riprap wall, east shore, Sandy Hook, N. J.

July 1, 1899, balance unexpended	$135.48
June 30, 1900, amount expended during fiscal year	.31
July 1, 1900, balance unexpended and available	135.17

Sea wall, north shore, Sandy Hook, N. J.

July 1, 1899, balance unexpended	$2,201.97
July 1, 1900, balance available	2,201.97

NATIONAL DEFENSE.

Gun and mortar batteries.

July 1, 1899, balance unexpended		$427.22
June 30, 1900, amount expended during fiscal year	$364.64	
June 30, 1900, amount deposited to credit of appropriation during fiscal year	62.58	
		427.22

Torpedo defense, southern entrance, New York Harbor.

July 1, 1899, balance unexpended	$50.58
June 30, 1900, amount deposited to credit of appropriation during the fiscal year	50.58

Supplies for coast defense.—Under date of June 7, 1900, an allotment of $1,000 was made by the Chief of Engineers, United States Army, from the appropriation for "Supplies for Coast Defense," act of May 25, 1900, to be applied to filling such requisitions as may be duly approved by him.

No supplies have yet been issued under this appropriation.

Money statement.

Amount allotted June 7, 1900	$1,000.00
Amount unexpended and available July 1, 1900	1,000.00

3 G.

DEFENSES OF THE DELAWARE RIVER.

Officer in charge, Lieut. Col. Charles W. Raymond, Corps of Engineers, to April 6, 1900, and since May 31, 1900; assistants, Lieut. Spencer Cosby, Corps of Engineers, to January 1, 1900, from February 21 to April 6, 1900, and since May 31, 1900; and Lieut. James B. Cavanaugh, Corps of Engineers, since June 11, 1900. The district was in charge, temporarily, of Lieut. Spencer Cosby from April 6 to May 31, 1900.

Battery for three 10-inch and three 12-inch disappearing guns.—The project under which this battery was constructed and a detailed account of the progress of the work and a description of the battery as constructed are contained in the Annual Reports of the Chief of Engineers for 1897, pages 628 to 636; for 1898, pages 637 to 639; and for 1899, pages 782 to 785.

The battery proper had been completed and the guns and carriages mounted in 1898, and it was turned over to the artillery commander on January 6, 1899.

At the end of the preceding fiscal year work was in progress on the earthen parados, which is to protect the battery from reverse fire, and 40,363 cubic yards of material, out of a revised estimate of 44,500 cubic yards, had been placed.

During the fiscal year this work was continued and the parados completed on September 19, 1899; 4,137 cubic yards of material were placed, making a total of 44,500 cubic yards in this work. The slopes were graded and seeded to prevent washing, and longitudinal strips of sod were placed on them 7 feet apart and securely pegged in position.

The work done on the battery proper during the fiscal year was in maintenance and repairs, such as cleaning and varnishing all the doors of the battery, repairing the drains from the wells under the ammunition elevators in emplacements Nos. 3, 5, and 6, which did not work properly, and painting the top surface of traverse No. 3 with two coats of linseed oil, thus effectually stopping some slight leaks which had appeared in the magazines.

Battery for 5-inch rapid-fire guns on balanced-pillar mounts.—The two emplacements for 5-inch rapid-fire guns on balanced-pillar mounts are situated about 100 feet beyond the western end of the main battery. A description of them and of the progress of the work is contained in the Annual Reports of the Chief of Engineers for 1898, pages 639 and 640, and for 1899, page 784. The battery was completed in August, 1897, ready for the guns and carriages. They have not yet been received, and this battery has not been turned over to the artillery commander.

The only work done on this battery during the fiscal year, under this allotment, was in changing the two platforms to conform to the change in the mounts. This work was begun on November 24, and the balance available, $20.06, was expended. Work was continued under a separate allotment from the appropriation for "Preservation and Repair of Fortifications," and was completed December 2, 1899, at a cost of $69.20. The platforms had to be cut down 1 foot to within 3.5 feet of the center, 6.5 cubic yards of concrete being removed from each platform. A pavement of Portland mortar 1 to 3, was then put on.

Correcting dampness in magazines.—On August 1, 1899, the Chief of Engineers allotted the sum of $550 from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to be applied to correcting the dampness of the magazines of the 10-inch, 12-inch, and 5-inch emplacements. This allotment was expended in putting in expanded-metal ceilings in all magazines to prevent condensation.

The ceilings consist of sheets of expanded metal lashed with wire to ⅜-inch diameter galvanized iron rods running longitudinally, 14 inches center to center, which are secured by steel hooks to 1-inch steel channels supported 3 inches under and parallel with each I-beam by ½-inch hooks tapped into the I-beams. The expanded metal was plastered with two coats of Portland mortar; the first coat containing about 25 per cent of lime with the usual quantity of hair used in plastering; the second coat was of Portland mortar, cement 1, sand 2. This gives a continuous air space 3 inches under the I-beams, extending over the whole surface of the magazines.

The allotment, due to increase in price of materials, was not sufficient to complete this work, and the balance, $222.03, was paid for, $106.21 from the allotment for the care of the electric light and power plant and $115.82 from the allotment for repairs to river bank and wharf. The cost of the ceilings in the 10-inch and 12-inch emplacements was $650.08, and that of the 5-inch emplacements $121.95, making a total of $772.03.

Construction of bracketed gallery and erection of board fence.—On November 8, 1899, the Chief of Engineers allotted the sum of $1,825 from appropriations for "Preservation and Repair of Fortifications," as follows:

Act of June 6, 1896	$100.00
Act of March 3, 1897	1,157.99
Act of May 7, 1898	307.80
Act of March 3, 1899	259.21
	1,825.00

to be applied to the construction of a bracketed gallery along the rear of the battery connecting the six gun platforms, and for the erection of a board fence to screen this battery from the public view.

The bracketed gallery was completed in May, 1900, at a cost of $1,223.29.

The board fence was completed in December, 1899, at a cost of $222.91.

Of the balance of this allotment, $15.40 was expended in May, 1900, in repairing the lead flashing on platform No. 1, $84.20 in June, 1900, in repairing the ceiling of the shot chambers of the 10-inch and 12-inch emplacements with cork paint where it had been injured by dampness, and $39.86 for the purchase of tools and supplies to be furnished the commanding officer.

Purchase of tools and supplies to be furnished the commanding officer.—On March 8, 1900, the Chief of Engineers allotted the sum of $150 from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for the purchase of tools and supplies to be furnished the commanding officer for the operation and maintenance of the electric plant at that post. This allotment was entirely expended.

Repairing slopes of parados.—On March 22, 1900, the Chief of Engineers allotted the sum of $300 from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to be applied to repairing the slopes of the parados. This allotment was entirely expended in April, 1900, in filling in the gullies washed in the slopes during the winter, and in placing sod cut from the surrounding meadows.

Care and operation of electric light and power plant.—Under an allotment of $1,150, made by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, the electric plant was cared for by a skilled mechanic of the classified service at a compensation of $75 per month from July 1, 1899, to November 4, 1899, inclusive, on which date an electrician sergeant was appointed to take charge of the plant.

On November 13, 1899, $400 was withdrawn from this allotment.

The balance of this allotment was expended in the purchase of tools and supplies for repairs and maintenance of the electric plant, in completing the expanded metal ceilings, and in changing the platforms of the 5-inch emplacements.

Under an allotment of $300 made by the Chief of Engineers on June 9, 1899, from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, repairs were made to the river bank and wharf, at a cost of $131.78. The balance of this allotment was expended in completing the expanded metal ceilings and in changing the platforms of the 5-inch emplacements.

On June 8, 1900, the Chief of Engineers allotted the sum of $500 from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, for necessary repairs.

The following table shows the expenditure on both main and rapid-fire batteries during the fiscal year:

4,137 cubic yards of earth in parados, at $0.39723 per cubic yard	$1,643.36
Grading, seeding, and sodding parados	108.02
Cutting drains in shot chambers of 10-inch and 12-inch emplacements	17.85
Varnishing doors of battery	11.25
Cleaning up inside and outside of battery	6.73
Mileage paid United States officers	4.62
Changing platforms of 5-inch emplacements	20.06
Time allowed employees for legal holidays	55.50
Superintendence and office expenses	267.20
Total	2,134.59

The following table shows the expenditure on the work of preservation and repair of fortifications during the fiscal year:

Expanded metal ceilings in 10-inch and 12-inch emplacements, in place	$650.08
Expanded metal ceilings in 5-inch emplacements, in place	121.95
Bracketed gallery, in place	1,223.29
Board fence, in place	222.91
Tools and supplies for commanding officer	456.88
Repairs to slopes of parados	300.00
Repairs to electric plant	49.97
Services of steam engineer for electric plant from July 1 to November 4, inclusive, 1899	310.00
Repairing lead flashing of platform No. 1	15.40
Repairing ceilings of shot chambers	84.20
Repairs to river bank and wharf	131.78
Changing platforms of 5-inch emplacements	69.20
Total	3,635.66

Emplacements for 5-inch rapid-fire guns on pedestal mounts.—On September 25, 1899, the Chief of Engineers allotted the sum of $17,500 from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, to be applied to the construction of emplacements for two 5-inch rapid-fire guns, segmental wire wound, to be located on the left flank of the 10-inch and 12-inch battery.

The only work done for the construction of these emplacements during the fiscal year has been to set up a derrick on the site of the emplacements and one on the wharf and to receive and store construction materials.

Contracts for construction materials were awarded as follows:

With Charles Warner Company, Wilmington, Del., dated January 27, 1900, and approved February 12, 1900, for about 900 cubic yards washed sand, at 28 cents per cubic yard, and 9,000 cubic yards unwashed sand, at 22 cents per cubic yard.

With the Brandywine Granite Company, Wilmington, Del., dated January 27, 1900, and approved February 16, 1900, for about 1,700 cubic yards of small broken stone, at $1.37 per cubic yard.

With William J. Donaldson, Philadelphia, Pa., dated April 30, 1900, and approved May 12, 1900, for about 1,400 barrels Alpha brand American Portland cement, of which about 400 barrels are to be delivered, at $2.21 per barrel.

Money statements.

MAIN BATTERY AND BATTERY FOR 5-INCH GUNS ON BALANCED-PILLAR MOUNTS.

July 1, 1899, balance unexpended		$3,680.00
June 30, 1900, amount expended during fiscal year		3,565.15
July 1, 1900, balance unexpended		114.85
July 1, 1900, outstanding liabilities		114.85
Amount expended to June 30, 1899		290,656.17
Amount expended during fiscal year		3,565.15
Outstanding liabilities to June 30, 1900		114.85
Total cost of work to June 30, 1900		294,336.17
Total amount of allotments		344,680.00
Transferred to other works	$25,343.83	
Withdrawn from allotments	25,000.00	
Expenditures and liabilities	294,336.17	
		344,680.00

EMPLACEMENTS FOR TWO 5-INCH GUNS ON PEDESTAL MOUNTS.

September 25, 1899, amount allotted		$17,500.00
June 30, 1900, amount expended during fiscal year		2,076.96
July 1, 1900, balance unexpended		15,423.04
July 1, 1900, outstanding liabilities	$165.54	
July 1, 1900, amount covered by existing contracts	7,674.97	
		7,840.51
July 1, 1900, balance available		7,582.53

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended		$1,450.00
August 1, 1899, amount allotted		550.00
November 8, 1899, amount allotted		1,825.00
March 8, 1900, amount allotted		150.00
March 22, 1900, amount allotted		300.00
June 9, 1900, amount allotted		500.00
		4,775.00
November 13, 1899, amount withdrawn	$400.00	
June 30, 1900, amount expended during fiscal year	3,594.06	
		3,994.06
July 1, 1900, balance unexpended		780.94
July 1, 1900, outstanding liabilities		41.60
July 1, 1900, balance available		739.34

Abstract of proposals for furnishing and delivering at the Government wharves cement, broken stone, and sand, opened January 20, 1900, by Lieut. Col. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Class A, natural cement.		Class B, Portland cement.		Class C, small broken stone.			
		Quantity 5,460 barrels, per barrel.	Total for class A.	Quantity 600 barrels, per barrel.	Total for class B.	Delivered on west side of river, 1,600 cubic yards, per cubic yard.	Delivered on east side of river, 1,700 cubic yards, per cubic yard.	Delivered at both places, 3,300 cubic yards, per cubic yard.	Total for class C.
1	Walter T. Bradley Co., Philadelphia, Pa			$2.49	$1,494.00				
2	Standard Lime and Stone Co., Baltimore, Md							$1.95	$6,435.00
3	John T. Dyer, Norristown, Pa							1.49	4,917.00
4	Charles Warner Co., Wilmington, Del	$1.05	$5,733.00	2.21	1,326.00				
5	The Brandywine Granite Co., Wilmington, Del					$1.56	$1.37		4,825.00
6	Atlas Portland Cement Co., New York, N. Y			2.60	1,560.00				
8	Benjamin Wallis, trading as B. Wallis & Co., Baltimore, Md	1.30	7,098.00						
9	Lawrenceville Cement Co., New York, N. Y	1.05	5,733.00						
10	New York and Rosendale Cement Co., New York, N. Y	1.02½	5,596.50						
11	Cyrus Borgner, trading as Borgner Cement Co., Philadelphia, Pa			2.26	1,356.00				

No.	Name and address of bidder.	Class D, washed sand.		Class E, unwashed sand.	
		Quantity 1,800 cubic yards, per cubic yard.	Total for class D.	Quantity 15,000 cubic yards, per cubic yard.	Total for class E.
4	Charles Warner Co., Wilmington, Del	$0.28	$504.00	$0.22	$3,300.00
7	Delaware Construction Co., Wilmington, Del			.23	3,450.00

Contracts entered into as follows:

1. With the Charles Warner Company, dated January 27, 1900, for the washed and unwashed sand. In progress.
2. With The Brandywine Granite Company, dated January 27, 1900, for the small broken stone. In progress.
3. With Cyrus Borgner, trading as Borgner Cement Company, dated April 14, 1900, for the Portland cement. Completed.

Abstract of proposals for furnishing and delivering American Portland cement, opened April 24, 1900, by Lieut. Spencer Cosby, Corps of Engineers.

[Approximate quantity, 1,400 barrels.]

No.	Name and address of bidder.	Delivered in barrels.		Delivered in sacks, 100 pounds.		
		Price per barrel.	Total.	Price per barrel.	Total.	Rebate on each sack returned.
						Cents.
1	Atlas Portland Cement Co., New York, N. Y.	$2.37	$3,318	$2.57	$3,598	10
2	Walter T. Bradley Co., Philadelphia, Pa.	2.60	3,640	2.80	3,920	10
3	William J. Donaldson, Philadelphia, Pa.	2.21	3,094	2.41	3,374	10
4	Samuel H. French & Co., Philadelphia, Pa.	2.46	3,444	2.64	3,696	10
5	Cyrus Borgner, trading as Borgner Cement Co., Philadelphia, Pa.	2.26	3,164	2.46	3,444	10

Contract (dated April 30, 1900) entered into with William J. Donaldson. In progress for one locality and completed for the other.

List of all contracts in force, with name of contractors, date of approval, of beginning work, and expiration.

1. With Charles Warner Company, of Wilmington, Del., dated January 27, and approved February 12, 1900, for furnishing and delivering about 900 cubic yards washed sand, at 28 cents per cubic yard, and 9,000 cubic yards unwashed sand, at 22 cents per cubic yard; first delivery of washed sand to be made in April, 1900, and thereafter deliveries to be made at the rate of about 150 cubic yards per week until completion of contract; first delivery of unwashed sand to be made in May, 1900, and thereafter deliveries to be made at the rate of about 250 cubic yards per week until completion of contract.
2. With The Brandywine Granite Company, of Wilmington, Del., dated January 27, and approved February 16, 1900, for furnishing and delivering about 1,700 cubic yards small broken stone, at $1.37 per cubic yard; times at which deliveries are to be made until completion of the contract to be determined by the engineer officer in charge.
3. With William J. Donaldson, of Philadelphia, Pa., dated April 30, and approved May 12, 1900, for furnishing and delivering about 1,000 barrels American Portland cement, at $2.21 per barrel; deliveries to be made at such times and in such quantities between May 1 and October 1, 1900, as may be required by the engineer officer in charge.

Battery for three 12-inch guns on disappearing carriages.—The project under which this battery is being constructed was approved July 22, 1896, and takes the place of the original project for a three-gun lift battery under which the work upon the foundations was begun. Under the original project the sum of $260,000 was, on August 11, 1894, allotted from the appropriation of August 1, 1894, for "Gun and Mortar Batteries." On July 30, 1895, $50,000 was withdrawn from this allotment, and on February 29, 1895, $70,000 more was withdrawn to be applied to the construction of a 10 and 12 inch battery.

On August 5, 1897, an allotment of $58,000 was made from the appropriation for "Gun and Mortar Batteries," act of March 3, 1897, to complete the concrete foundations up to the level of the parade. On December 20, 1897, $10,000 was withdrawn from this allotment.

On July 20, 1898, a provisional allotment of $150,000 was made by the Chief of Engineers from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, to be applied to the construction of the three emplacements.

On February 28, 1900, the sum of $12,500 was allotted by the Chief of Engineers from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, to be applied to the completion of the three emplacements.

The estimated cost of this battery is $357,200.

The preliminary work on the foundations of this battery began on December 11, 1894. Accounts of the progress of the work are continued in the Annual Reports of the Chief of Engineers for 1895, 1896, 1897, 1898, and 1899.

At the close of the last fiscal year $261,877.39 had been expended upon the battery, and its condition was, briefly, as follows:

Nineteen thousand six hundred cubic yards of material had been excavated for the foundations. All the piles for the foundations, 4,627 in number, had been driven and 24,070 cubic yards of concrete masonry and 9,375 cubic yards of sand and earth filling had been placed, bringing the mean masonry level for emplacements 1 and 2 up to reference (35) above the piles, and for emplacement No. 3 to reference (31), and the sand filling up to reference (21). The anchor bolts in all three platforms had been set. Disappearing gun carriage No. 13 had been received and stored, with the exception of two carloads of parts which had been wrecked near Wilmington, Del.

During the fiscal year concrete construction was continued until November 17, 1899, when the concrete work of the whole battery was completed, including the pavements on the superior slope and on the barbette of the old fort, as well as the pavements in the rooms and passages, 6,741 cubic yards being placed.

The completed battery contains 30,811 cubic yards of concrete masonry, of which 29,809 cubic yards are Rosendale and Portland concrete in the battery proper and 1,002 cubic yards are Portland concrete in the three platforms.

The pavement on the superior slope, aggregating 2,509 square yards, was constructed in slabs about 6 by 10 feet and about 18 inches in thickness, as follows:

The concrete surface was first swept clean and free from loose stones and moistened, and then a thick Rosendale grout was spread over it just before the first layer of concrete was put on. This was of Rosendale concrete, 1:2:5, well rammed to a thickness of 6 inches. Over it, while still soft so as to bond in with it, was placed a 6-inch layer of Portland concrete, 1:3:7½. Before the last layer had had time to set fully it was covered with a 3-inch layer of Portland concrete, 1:2:5, and before this had had time to set fully the final or granolithic layer, 3 inches thick, composed of 1 part Portland cement, 1½ parts sand, and 2 parts ⅜-inch granolithic stone, was put on. This last layer was floated off one-eighth inch below grade, and over it, to bring it to the true grade, was spread a coating of 1 part Portland cement and 1 part sand, mixed wet and darkened with 1½ per cent, by weight, of mineral black. This last layer, after being floated to a smooth surface on the true grade, was sifted over with a dry mixture of Portland cement 2, and sand 1, mixed with 1½ per cent of mineral black. The surface was then carefully troweled to a smooth surface by experienced masons. Only the quantity was started that could be completed during each day. The vertical joints are made transverse to the line of the interior crest, except at the flanks, where they are made radially from the gun centers.

The pavement on the barbette of the old fort over bastions 5–1, 1–2, 2–3, and fronts 1 and 2, aggregating 1,475 square yards, consists of a layer of about 11 inches of Rosendale concrete floated over with 1 inch of Portland mortar, 1 to 3, carefully floated to the true grade and troweled to a smooth finish. The granite capstones over the ventilating shafts from the casemates below were reset at the level of and just inside of the coping of the old fort, and the concrete masonry was sloped at an angle of 45 degrees to the pavement, 29 inches below. This whole paved surface of the barbette, as well as the whole superior slope of the three 12-inch emplacements, is drained into the manholes of the drainage system for the barbette of the old fort, emptying into the cisterns under fronts 1 and 2.

All exterior face walls of the battery are faced with 2 inches of Portland mortar, 1 to 3, rubbed smooth and then finished by rubbing with hard fire brick. The interior face walls of the magazines and casemates on the first and second tiers are faced with 2-inch tile furring placed against the rough concrete walls, having an air space between it and the walls behind. The air space is drained by pipes connecting with the main drainage system. This furring, aggregating 9,472 square feet, as well as the 11,960 square feet of hollow tiles in the ceilings of the battery proper and 840 square feet in the ceilings of the east and west passages, were plastered with a thin coat of Portland mortar, 1 to 3. All other interior face walls, as well as all the floors of the battery, were covered with Portland mortar, 1 to 4.

One thousand and six and seventy-five one-hundredths square yards of asphalt pavement, 1½ inches in thickness, were laid in two layers of three-fourths inch each on the platforms and steps around the gun pits, by contract at a cost of $1.62 per square yard; 192.43 square yards of asphalt paint were put on the vertical faces of the platform steps and counterweight wells by contract, at a cost of 90 cents per square yard, and 217.40 square yards of asphalt pavement, 1 inch in thickness, were laid on the roof of the boiler room by contract, at a cost of $1.44 per square yard.

The asphalt pavement is raised 1 inch where it joins the vertical walls of the parapet, and strips of lead flashing, one-eighth inch by 6 inches, are set in a groove 1½ inches deep at the level of the pavement, to prevent leakage through the vertical joints, 385 linear feet of lead flashing being placed on the platforms and 111 linear feet around the roof of the boiler room.

Six thousand seven hundred and eighty-one cubic yards of purchased sand and 1,490 cubic yards of earth and débris from the barbette of the old fort and from the excavation for the 15-pounder rapid-fire batteries were placed for filling on the front of the battery proper and under the arches on fronts 3 and 5. This work was completed in November, 1899, a total of 17,646 cubic yards being placed, of which 13,136 cubic yards were purchased sand. The sand filling was leveled in layers and carefully tamped, and settled with water from a steam pump to guard against settlement.

The electric wiring for light and power was installed throughout the battery, except in the power house, the switch board not having been received, all the wiring in the first tier being carried in iron-armored insulated conduit, and all the lamps being inclosed in the Navy Standard moisture-proof glass globes, protected by a wire guard, while in the second tier all the wiring is on cleats, and the lamps are unprotected. All of the switches for the lighting circuits are metal push-button switches containing no fiber or other material to be affected by moisture.

The following parts of the battery were installed complete:

Seven electric exhaust fans, from one-fourth to 1 horse power, for ventilating the magazines and casemates.

The trolley system, including three turntables, for ammunition service.

Drainage system, including connections with the main sewer through the parade.

Water supply for the whole battery, including 2 iron tanks of 2,250 gallons capacity each, placed on the barbette of the old fort, front 5, and a 3-inch suction pipe, 530 feet in length, from the power house across the moat to the artesian well in the meadow on the west side of the fort.

Three stationary ammunition cranes, one for each gun, standing on the rear of the platforms. Details of these cranes are shown on sheet 1.

Three balconies, one in the rear of each gun, with hand railing extending along the whole length of the platform,

Twelve windows, with ½-inch steel shutters, in the rear wall of the battery.

Six iron stairways, 3 straight and 3 spiral.

Iron ladders from platform to parapet and to observation stations.

The two Westinghouse standard engines, direct connected to American Engine Company's 15-kilowatt generators, were moved from the temporary power house outside the fort, where they had been in use during the past four years for construction purposes in connection with a trolley system, and placed in their permanent positions in the power house. The 60-horsepower boiler is unserviceable, on account of corrosion by the bad water used before the artesian well was sunk, and the old switch board was too small for use in the new work. A new boiler and switch board, as well as a storage battery of the normal capacity of 25 amperes at 125 volts for eight hours, have been ordered, but had not been delivered at the close of the fiscal year. A tracing showing details of switch board, and marked sheet 2, accompanies this report.

A coal bin with a capacity of 75 tons of coal was constructed of bricks, from the old buildings torn down, immediately in the rear of the power house.

Permanent railroad tracks from the two entrances of the battery and from the cable storage tank were laid on the parade, connecting at the sally port with the main track.

Five hundred and forty-five square yards of flagstone pavements and 373 linear feet of curbing and brick gutter were laid on the parade along the new work, connecting with the old pavements. Four hundred and forty-two square yards of flagstone pavement and 120 square yards of concrete pavement were laid in the casemates on the first and second tiers of fronts 1, 2, and 3, to replace the flagstone pavements which had been torn out for pile driving for the foundations of the battery.

Flagstone and curbing removed from the old fort were used for all this work. Four hundred and fifty-six square yards of the old flagstone pavements around the parade, which were very uneven, were relaid and 220 linear feet of curbing and brick gutter reset.

The brick walls and arches of the old fort in the rear of the new work, which were left in a very bad condition by the removal of the old buildings, were repaired, part of the cost of which was paid for from the allotment from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898.

The fronts of casemates Nos. 26 and 27, on the first tier on front 3, which were torn out to run construction tracks through, were rebuilt with cut stone backed with concrete, the embrasures being rebuilt to conform with the old work.

At the end of the fiscal year all the doors for the battery had been hung, with the exception of the six magazine doors, which had not been delivered. The grading of the parade was nearly completed ready for seeding; the pavements and walls for the latrines had been constructed, and the interior fittings had been delivered but had not been set.

Armament: The three 12-inch disappearing guns and carriages were received as follows: 12-inch B. L. rifle No. 18, model 1895, July 21, 1899; 12-inch B. L. rifle No. 15, model 1895, August 28, 1899; 12-inch B. L. rifle No. 20, model 1895, December 1, 1899; 12-inch disappearing carriage No. 13, L. F. model 1896, June 21 and July 13, 1899; 12-inch disappearing carriage No. 14, L. F. model 1896, August 18 and 28, 1899; 12-inch disappearing carriage No. 15, L. F. model 1896, November 12 and 24, 1899.

These guns and carriages were unloaded from the cars and car floats, and moved from the wharf and stored, at a cost of $985.46.

The construction of the trestle for mounting the guns and carriages was begun on November 24, 1899. The trestle was located on the parade, in the rear of emplacement No. 2, and was 150 feet in length and, at the highest part, 29.5 feet high above the parade. It was constructed of old timber from the concrete plants at the 8-inch and 12-inch and mortar batteries, transferred for this purpose.

The mounting of the carriages was begun on December 11, 1899. It was impossible to get the bedplate, racer, and chassis castings into the fort through the sally port, so the temporary entrance through the scarp wall on front 3 was enlarged by cutting out the masonry on each side to make the opening wide enough, and the temporary bridge over the moat was strengthened to carry the weight. The parts of the carriages were taken inside the fort on cars, and all parts of 5 tons or less in weight were hoisted into place by two 80-foot derricks, which were left on the platforms where they had been in use for concrete construction, while the heavy parts were taken up the inclined trestle on a cradle and rollers. The mounting of the three carriages was completed, as far as it could be carried before the guns were mounted, on February 8, 1900, and the mounting of the guns began on February 9, 1900. The temporary bridge over the moat on front 3 not being strong enough to carry the weight of the guns, they had to be hauled on a cradle and rollers around the north side of the fort and through the sally port on front 5, a distance of 1,300 feet.

The mounting of the guns and carriages was completed as follows:

Emplacement No. 1, carriage No. 13, gun No. 15, mounted March 14, 1900.

Emplacement No. 2, carriage No. 14, gun No. 18, mounted March 24, 1900.

Emplacement No. 3, carriage No. 15, gun No. 20, mounted March 5, 1900.

The breechblocks were put in place as soon as the guns were mounted. The work was delayed during the winter by severe cold and stormy weather and ice in the river, which prevented the working force from getting to the fort.

No work was done except during favorable weather. The total cost of mounting the three guns and carriages, including the transfer across the river of the timber and the erection and removal of the trestle, was $3,857.96. During the month of April, 1900, the guns and carriages were thoroughly cleaned and painted.

All of the old guns and carriages, mounted and unmounted, with the exception of fifteen 8-inch converted rifles mounted in fronts 1, 2, and 3, together with a miscellaneous lot of shot and shell, were sold by the Ordnance Department on May 10, 1900. The removal of this ordnance by the contractor had just begun at the close of the fiscal year.

At the end of the fiscal year the battery was practically completed, the principal work remaining to be done being the installation of the three ammunition hoists, the installation of the 60-horsepower boiler, switch board and storage battery for the electric plant, completing the latrines, the hanging of the doors of the magazines, and the grading and seeding of the parade.

The total cost of the battery up to June 30, 1900, was $334,229.27.

The following contracts were in force during the year:

With the Lawrence Cement Company, of New York, N. Y., dated September 15 and approved October 8, 1898, for furnishing and delivering 36,000 barrels American Rosendale cement, at 68 cents per barrel; first delivery to be made between September 25 and October 1, 1898; final delivery to be made before September 1, 1899. This contract was satisfactorily completed on August 2, 1899, 25,036 barrels having been delivered under it.

With John T. Dyer, Norristown, Pa., dated September 15 and approved September 28, 1898, for furnishing and delivering 24,000 cubic yards of small broken stone, at 98 cents per cubic yard, and 5,000 tons of large broken stone, at 73 cents per ton of 2,240 pounds; first delivery of small broken stone to be made between September 20 and October 1, 1898; final delivery to be made on or about September 30, 1899; extended to December 1, 1899. First delivery of large broken stone to be made before September 25, 1898; final delivery to be made before August 30, 1899; extended to December 1, 1899. This contract was satisfactorily completed on November 4, 1899, a total of 15,876.16 cubic yards of small broken stone and 3,373.47 tons of large broken stone having been delivered under it.

With Charles Warner Company, of Wilmington, Del., dated September 15 and approved October 18, 1898, for furnishing and delivering 9,000 cubic yards of washed sand, at 28 cents per cubic yard, and 18,000 cubic yards of unwashed sand, at 24 cents per cubic yard; first delivery of washed sand to be made between September 20 and 25, 1898; final delivery to be made on or about September 30, 1899; extended to December 1, 1899. First delivery of unwashed sand to be made on or about December 1, 1898; final delivery to be made on or before September 30, 1899; extended to December 1, 1899. This contract was satisfactorily completed on November 6, 1899, a total of 7,518.54 cubic yards of washed sand and 9,165.08 cubic yards of unwashed sand having been delivered under it.

With the Commercial Wood and Cement Company, of Wilmington, Del., dated October 10, and approved October 27, 1898, for furnishing and delivering about 4,000 barrels American Portland cement at $2.10 per barrel; first delivery to be made on or before September 25, 1898; final delivery on or before September 1, 1899. This contract was satisfactorily completed, 5,500 barrels having been delivered under it.

With Vulcanite Paving Company, of Philadelphia, Pa., dated September 7, 1899, and approved September 29, 1899, for covering with asphalt the concrete platforms, steps, and roof of the 12-inch battery, at $1.62 per square yard for 1½ inches in thickness and $1.44 per square yard for 1 inch in thickness. This contract was satisfactorily completed on November 15, 1899, 1,006.75 square yards of pavement 1½ inches in thickness and 217.40 square yards 1 inch in thickness having been laid. In addition to the above 192.43 square yards of asphalt painting was done under oral agreement.

With Messrs. L. Schutte & Co., of Philadelphia, Pa., dated March 22, 1900, and approved April 4, 1900, for furnishing and delivering three chain ammunition hoists for the 12-inch guns, at the price of $1,080 each; delivery to be made within three months from April 6, 1900.

The following tables show the quantity and cost of each kind of material used and the total cost of the work to June 30, 1900:

Quantity of each kind of material used and average cost, delivered on or alongside the wharf.

4,882 piles, 50 feet long, per linear foot	$0.15979
37,609 barrels Rosendale cement, per barrel	.68726
5,400 barrels Portland cement, per barrel	2.10
24,147.78 cubic yards small broken stone, per cubic yard	1.0209
4,922.12 tons large broken stone, per ton	.7368
10,022.03 cubic yards washed sand, per cubic yard	.28
13,135.25 cubic yards unwashed sand, per cubic yard	.24302
209 cubic yards granolithic stone, per cubic yard	2.00
197,098 pounds steel I-beams and channels, per pound	.014528
78 anchor bolts (36 at $7 and 42 at $9 each)	630.00
636 feet cast-iron pipe, 4-inch, 6-inch, 8-inch, and 24-inch	394.95
7,145 feet extra heavy wrought-iron pipe, ¾-inch, 1-inch, 1½-inch, 2-inch, 3-inch, 3½-inch, and 4-inch	482.94
232 feet sewer pipe, 24-inch, per foot	.5975
12 cast-iron manholes, each	7.45
199,122 feet yellow-pine lumber, per 1,000 feet	20.00
768 feet white-pine lumber, per 1,000 feet	41.66
25,192 feet hemlock, per 1,000 feet	13.60
696 feet oak lumber, per 1,000 feet	40.00
2,000 feet novelty siding, per 1,000 feet	30.00
2,012 feet spruce, per 1,000 feet	17.00
18,000 shingles, per 1,000	4.00
1,203 railroad ties, each	.40
48 tons steel rails, per ton	26.19
1,600 pounds railroad spikes, per pound	.0175
1,450 pounds dock spikes, per pound	.019
360 pairs fish plates, per pair	.25
12 split switches, each	25.64
923 tons anthracite coal, per ton	4.41
162 tons bituminous coal, per ton	1.90
14,823 pounds iron, per pound	.0281
331 pounds round machinery steel, per pound	.033
30 barrels coal tar, per barrel	3.82
10,700 pounds cut nails, per pound	.01581
810 feet iron armored conduit, 2¼-inch, 1$\frac{8}{10}$-inch, 1$\frac{4}{10}$-inch, $\frac{9}{10}$-inch, and $\frac{7}{10}$-inch, including connections	302.92
11,272 feet electric wire, Nos. 3–0, 2–0, 1–0, 0, 2, 5, 6, 10, 12, and 14	322.18
3,300 feet trolley wire, No. 0, per foot	.035
1,224.15 square yards mastic, per square yard, in place	1.588
192.43 square yards asphalt paint, per square yard, in place	.90
4,000 hollow burnt-clay bricks, each	.035
10,600 square feet 2-inch furring, per square foot	.03
12,800 square feet of hollow burnt-clay tile, per square foot	.108
8 wrough-iron trolleys, each	35.00
8 fan-motor outfits	890.00
3 straight iron stairways, each	110.00
3 balconies, each	48.00
3 ammunition cranes, each	269.00
3 overhead turntables, each	40.00
3 spiral stairways, each	107.00
1,961 pounds sheet lead, per pound	.05
14,022 square feet expanded metal, per square foot	.047
12 white-oak window frames	375.00
15 double steel doors	919.00
12 double steel shutters	530.00

AVERAGE COST OF HANDLING MATERIALS.

Piles, each, unloading	$0.58191
Cement, per barrel:	
Unloading	.02854
Hauling	.00296
Storing	.01598
Small broken stone, per cubic yard:	
Unloading	.16441
Hauling	.01883
Storing	.02438
Sand for concrete, per cubic yard:	
Unloading	.11354
Hauling	.0084
Storing	.0181
Large broken stone, per ton:	
Unloading	.168
Hauling	.03105
Storing	.0753
Placing in walls	.1272
Sand for filling, per cubic yard:	
Unloading	.12486
Hauling	.02254
Placing and tamping	.1818
Excavation, per cubic yard	.42841
Setting anchor bolts, each	.944

AVERAGE COST OF MATERIALS IN PLACE.

Piles in foundations, 4,680 (including 53 used for splicing):	
4,680 piles, cost of	$37,401.28
Unloading	2,840.91
Driving	11,658.29
Taking down pile driver	110.13
Removing pile ends from pit	305.75
Cutting off pile heads	510.47
Total	52,826.83

Cost per pile (4,627) in place, $11.41708.

Concrete masonry in walls of magazines and galleries, 28,063 cubic yards:	
Materials (cement, sand, small and large stone, and coal)	70,953.15
Framing (labor, etc.)	7,366.29
Mixing	5,510.60
Placing and ramming	10,787.60
Preparing floors and laying pavements in magazines and galleries	604.58
Testing cement	835.87
Total	96,058.09

Cost per cubic yard in place, $3.42294.

Concrete masonry in the three platforms, 1,002 cubic yards:	
Materials (cement, sand, and stone)	4,281.90
Framing (labor, etc.)	519.44
Mixing	239.20
Placing and ramming	521.34
Cost of anchor bolts	693.00
Labor (setting bolts)	73.64
Total	6,328.52

Cost per cubic yard in place, $6.315888.

Concrete pavement of superior slope, 1,286 cubic yards (2,509 square yards):	
Materials (cement, sand, stone, etc.)	5,225.31
Framing (labor, etc.)	681.99
Mixing, placing, and finishing	1,738.74
Total	7,646.04

Cost per cubic yard in place, $5.9456.

Concrete pavement on barbette of old fort, 460 cubic yards (1,475 square yards):

Materials (cement, sand, and stone)	$1,533.52
Framing (labor, etc.)	166.80
Mixing, placing, and finishing	735.45
Total	2,435.77

Cost per cubic yard in place, $5.29515.

Sand filling, 17,646 cubic yards:

3,970.17 cubic yards sand, at 25 cents per cubic yard	992.54
9,165.08 cubic yards sand, at 24 cents per cubic yard	2,199.61
4,510 cubic yards of earth and débris from barbette (labor placing)	1,162.33
Unloading	1,640.09
Hauling	296.25
Placing and tamping	2,387.95
Shifting tracks and maintenance of plant	729.65
Storage bin on wharf	41.36
Total	9,449.78

Cost per cubic yard in place, $0.535519.

COST OF MOVING AND MOUNTING THREE 12-INCH B. L. RIFLES AND DISAPPEARING CARRIAGES.

Setting bedplates and racers	$169.08
Moving and assembling carriages	2,152.64
Moving 12-inch rifles	388.38
Mounting 12-inch rifles	636.43
Building and tearing down trestle	511.43
Total	3,857.96

TOTAL COST OF WORK TO JUNE 30, 1900.

28,063 cubic yards of masonry in walls of magazines and galleries, at $3.42294 per cubic yard	$96,058.09
1,002 cubic yards of masonry in the three platforms, at $6.315888 per cubic yard	6,328.52
1,286 cubic yards of masonry in pavement on superior slope, at $5.9456 per cubic yard	7,646.04
460 cubic yards of masonry in pavement on barbette of old fort, at $5.29515 per cubic yard	2,435.77
19,600 cubic yards of excavation for foundations, at $0.428414 per cubic yard	8,396.92
17,646 cubic yards of sand and earth in sand cores, at $0.535519 per cubic yard	9,449.78
4,627 piles in foundations, at $11.41708 each	52,826.83
Removing earth from barbette of old fort	2,273.67
Tearing down barracks	3,011.35
Tearing out cisterns and arches	1,947.02
Taking up flagstone pavement	471.47
Moving old guns and carriages	1,693.28
Lift mechanism (tubes)	492.63
Test borings	196.09
Repairs and maintenance of quarters	2,106.34
Repairs to landing piers	8,970.94
Cleaning out moat	2,130.87
Preliminary survey	494.12
Handling submarine material	326.21
Purchase, construction, and installation of plant	16,601.55
Purchase, construction, and installation of electric construction plant	6,089.54
Electric light and power plant (not completed)	4,124.60
Plant for permanent water supply	471.62
Repair and maintenance of plant	12,339.59
Auxiliary lights for magazines	318.86
Cost of I-beams and channels, 197,098 pounds	2,863.46
Cost of connecting I-beams and channels	1,068.84

Moving and mounting guns and carriages	$3, 857. 96
Unloading and storing guns and carriages	985. 46
Cleaning, oiling, and painting guns and carriages	171. 33
Drainage system	1, 351. 36
Telephone system (not completed)	6. 85
Cleaning and grading inside and outside of fort	1, 716. 37
Extinguishing fire in room of barracks, and repairing same	184. 07
Derrick and rigging work	6, 138. 68
Construction track	4, 662. 27
Construction of bridge over moat	99. 44
Changes made in plans (west passage)	691. 06
Speaking-tube system	24. 47
Three ammunition cranes in place	996. 75
Trolly system for ammunition service	1, 253. 92
Stairways, balconies, and hand railing in place	1, 444. 51
Observation stations	32. 82
Iron ladders in place	178. 71
Ventilating system	1, 300. 36
Transferring and storing engineer property	488. 96
Repairs to walls of old fort	753. 63
Doors, windows, and shutters in place (not completed)	874. 51
Laying flagstone pavements in casemates of old fort	257. 82
Laying flagstone pavements on parade	751. 02
Waterproofing exterior wall with coal tar	259. 34
Finishing face walls	1, 646. 20
Asphalt in place on platforms	2, 391. 02
Metal flashing on platforms and power house in place	190. 37
Tile ceilings of magazines and passages	2, 893. 96
Tile furring on walls of magazines and casemates	1, 312. 64
Expanded metal in place	683. 39
Watching Government property	52. 00
Latrines (not completed)	288. 42
Coal bin	184. 64
Permanent railroad track (not completed)	203. 29
Stair shelters (not completed)	220. 17
Taking down plant	188. 75
Time allowed employees for legal holidays	2, 337. 34
Instruments and office furniture	936. 75
Printing and advertising	697. 72
Mileage paid United States officers	673. 36
Philadelphia office expenses	6, 342. 69
Maintenance of launch for mail service	8, 659. 79
Superintendence and office expenses	22, 228. 91
Material on hand and transferred to other works	2, 482. 17
Total	334, 229. 27

Preservation and repair of fortifications.—Under an allotment for the previous fiscal year the wharves were filled in during August, 1899, where the material had been washed out by storms, at a cost of $50.60.

Sixty barrels of Portland cement were purchased, at a cost of $135, for plastering the exposed walls of the old fort and in making various repairs.

The projecting parts of arches left where the buildings had been torn down were chipped off, and the walls put in as good condition as possible; $130.23 were expended on this work.

A set of cable-testing instruments was purchased, at a cost of $155, under authority of the Chief of Engineers dated December 22, 1899, for testing the insulation of the torpedo cable stored under water.

On June 8, 1900, the sum of $850 was allotted by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, to be applied to necessary repairs and for a skilled mechanic for caring for and operating the electric plant for six months.

Emplacements for 15-pounder rapid-fire guns.—The project under which these batteries are being constructed and an account of the progress to the end of the last fiscal year are contained in the Annual Report of the Chief of Engineers for 1899, page 790.

At the close of the last fiscal year the sites had been cleared and the excavations for the foundations completed, and 89 cubic yards of Rosendale concrete had been placed for the left-flank emplacements, completing the magazines, and 27 cubic yards for those of the right flank. As the emplacements are built in and form a part of the side parapet walls of the 12-inch battery, work on their construction during the fiscal year was carried on only as the construction of the 12-inch battery progressed.

During the fiscal year 227 cubic yards of Rosendale concrete were placed for the left-flank emplacements, and 300 cubic yards for those of the right flank, completing these emplacements with the exception of the central part of the gun platforms, about 12 cubic yards for each battery, which can not be put in until the iron curbings for the pillar mounts are received.

The pavements in the magazines and passages, the electric wiring for lights and power, and an electric fan for ventilating the magazines of each battery, were put in place. Iron stairways leading from the parade to each battery and iron ladders to the observation stations were erected and painted. This work was completed in November, 1899.

The following contract had been entered into:

With the Ellicott Machine Company (Canton), Baltimore, Md., dated March 22, 1900, and approved April 11, 1900, for furnishing and delivering two double-chain ammunition hoists for the right and left flank guns, by July 10, 1900, at the price of $984 each.

Money statements.

12-INCH EMPLACEMENTS.

July 1, 1899, balance unexpended		$84,969.18
February 28, 1900, amount allotted		12,500.00
		97,469.18
June 30, 1900, amount expended during fiscal year		79,106.17
July 1, 1900, balance unexpended		18,363.01
July 1, 1900, outstanding liabilities	$2,340.91	
July 1, 1900, covered by existing contracts	6,770.00	
		9,110.91
July 1, 1900, balance available		9,252.10

15-POUNDER EMPLACEMENTS.

July 1, 1899, balance unexpended	$6,849.12
June 30, 1900, amount expended during fiscal year	4,442.42
July 1, 1900, balance unexpended	2,406.70
July 1, 1900, amount covered by existing contracts	2,129.00
July 1, 1900, balance available	277.70

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$623.61
June 8, 1900, amount allotted	850.00
	1,473.61
June 30, 1900, amount expended during fiscal year	470.83
July 1, 1900, balance available	1,002.78

Abstract of proposals for furnishing and delivering and putting in place asphalt covering, opened August 12, 1899, by Lieut. Col. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantities.		Amount.
		1,090 square yards asphalt, 1¼ inches thick, in place, per square yard.	210 square yards asphalt, 1 inch thick, in place, per square yard.	
1	Sicilian Asphalt Paving Co., New York, N. Y.	$1.71	$1.44	$2,166.30
2	W. S. P. Shields, Philadelphia, Pa	2.27	1.53	2,795.60
3	American Artificial Stone Pavement and Construction Co., Philadelphia, Pa.	3.00	3.00	3,900.00
4	Vulcanite Paving Co., Philadelphia, Pa	1.62	1.44	2,068.20
5	T. Hugh Boorman, New York, N. Y	1.74	1.29	2,167.50

Contract (dated September 2, 1899) entered into with Vulcanite Paving Company.

Abstract of proposals for furnishing and delivering alongside the Government wharf five chain ammunition hoists, opened March 12, 1900, by Lieut. Col. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Class 1—For high-power guns.		Class 2—For rapid-fire guns.	
		Including beams, channels, etc., required, 3 (each).	Total.	Including two sets of guard rails, 2 (each).	Total.
1	Greenlie, Wyaat & Co., New York, N. Y.	$1,787.00	$5,361.00	$1,497.00	$2,994.00
2	The Exeter Machine Works, Pittston, Pa.	3,975.00	11,925.00	3,780.00	7,560.00
3	A. W. Isele & Sons, Boston, Mass	1,343.15	4,029.45		
4	Ellicott Machine Co., Baltimore, Md.	1,692.00	5,076.00	984.00	1,968.00
5	Robt. S. Bishop, New York, N. Y	1,725.00	5,175.00	1,035.00	2,070.00
6	L. Schutte & Co., Philadelphia, Pa.	1,080.00	3,240.00	1,010.00	2,020.00
7	New Jersey Foundry and Machine Co., New York, N. Y.	1,895.00	5,685.00	1,190.00	2,380.00
8	Geo. C. Howard, Philadelphia, Pa	964.00	2,892.00	1,424.00	2,848.00

Contracts entered into as follows:

1. With L. Schutte & Co., dated March 22, 1900, for the hoists for high-power guns. In progress.
2. With the Ellicott Machine Company, dated March 22, 1900, for the hoists for rapid-fire guns. In progress.

List of all contracts in force, with names of contractors, date of approval, of beginning work, and expiration.

1. With L. Schutte & Co., of Philadelphia, Pa., dated March 22, and approved April 4, 1900, for furnishing and delivering three chain ammunition hoists for high-power guns, at $1,080 each; delivery to be made within three months from April 6, 1900.
2. With the Ellicott Machine Company, of Baltimore, Md., dated March 22, and approved April 11, 1900, for furnishing and delivering two double-chain ammunition hoists for rapid-fire guns, at $984 each; delivery to be made by July 10, 1900.

Battery for sixteen 12-inch breech-loading mortars.—The approved project under which this work is being carried on and a detailed account of the progress of the work is contained in the Annual

Reports of the Chief of Engineers for 1898, pages 643 to 649, and for 1899, pages 790 to 793.

At the close of the last fiscal year all the masonry of the battery, aggregating 17,118 cubic yards, had been completed, and all of the sixteen mortar carriages and eight of the mortars had been mounted. There had also been placed in the embankments 117,695 cubic yards of sand and earth, completing them except for 118 cubic yards of earth facing and the grading and seeding of a part of the slopes, upon which work was in progress at the close of the year.

At the beginning of the fiscal year 118 cubic yards of earth were placed, completing the facing of the slopes, and the slopes were graded and then sown with rye and grass seed. This work was completed in August, 1899.

The temporary outlet of the 12-inch main drain for the battery at the inshore end of the sea wall on the upper side of the old wharf was taken up, and the drain was extended down the wharf inside the crib work 481 feet to the end of the wharf. An automatic valve of cast iron, 12 inches in diameter, was placed at the end of the wharf, at reference 1.25 above mean low water, for the permanent outlet.

The ground in the rear of the battery was graded and a brick gutter 24 inches wide and 375 feet in length was constructed, 34 feet from the foot of the earth slopes, to give surface drainage away from the battery.

The permanent railroad tracks in front of the battery, which had frequently been covered with water at high tide, were raised to reference 11.0, and the adjacent ground and permanent roadway to the wharf were graded to this level. The permanent railroad track from the wharf and transfer bridge was extended around the north end to the rear of the battery and into the two entrances of the battery as far as the main gallery.

The iron stairway leading to the observation station on the embankment over the firing room was received on August 26, 1899, and erected in place on the rear of the slope. An iron water tank, capacity 2,700 gallons, was placed on the top of the embankment and connected with the permanent water-supply system.

Powder carriers were received and placed in position. Iron brackets and hooks were constructed and placed in the walls of the galleries for holding rammers, sponges, and rubber hose.

Surface drains of 6-inch sewer pipe were laid under the pavements of the transverse galleries from the northeast and southeast pits to the brick gutter at the rear, to prevent flooding of the galleries during heavy rains which might occur while the outlet of the main drain was closed by the tide.

One hundred and seven granite blocks, one-half to 5 tons in weight, were removed from the rear to the front of the battery and stored along the railroad track leading to the 8 and 12-inch battery.

To prevent condensation of moisture on the **I**-beams and other iron work in the ceilings of the magazines false ceilings were constructed in October and November, 1899, consisting of sheets of expanded metal lashed with wire to three-eighth-inch diameter galvanized-iron rods running longitudinally, 14 inches center to center, which are secured by steel hooks to 1-inch steel channels supported 3 inches under and parallel with each **I**-beam by one-half-inch iron hooks tapped into the **I**-beams. The expanded metal was plastered with two coats of Portland mortar; the first coat containing about 25 per cent of lime, with the usual quantity of hair used in plastering; the second coat was Portland mortar, cement 1, sand 2. This gives a continuous air space 3 inches under the I-beams, extending over the whole surface of the magazines. Observations during May and June, 1900, show the experiment to have been entirely successful. In addition to the false ceilings an electric exhaust fan for ventilation was placed in the rear of each magazine in an inclosure 4 feet by 4 feet 4 inches constructed of hollow brick. The fans discharge through pipes extending up through the earth embankment to the open air, and are capable of changing the whole volume of air in the magazines every twenty minutes.

For the better drainage of the annular space around the bedplates of the mortar carriages a hole 2¼ inches in diameter was drilled, at an angle of about 45 degrees, under the bedplate of each carriage to the center pit under the carriage.

The storage battery was kept charged during the year for furnishing light and power.

The following table shows the expenditure during the fiscal year:

118 cubic yards of earth facing, placed by wheelbarrows, at $0.83 per cubic yard	$97.94
Grading and seeding slopes of embankment	1,564.50
Completing drainage system	752.37
Plant for permanent water supply	62.11
Cleaning and grading grounds	725.02
Completing permanent roadway, including railroad track	581.48
Cost and installation of powder carriers, and racks and brackets for rammers, staves, and hose	234.44
Completing observation station, including stairway	318.84
Repairs and maintenance of plant	70.05
Taking down concrete plant	64.85
Maintenance of storage battery	456.95
Finishing face walls of blast slopes	11.20
Relaying and repairing pavements in magazines and entrances to mortar pits	119.97
Watching Government property	41.34
Repairs to storage battery, electric wiring, water-supply plant, etc	42.49
Cost and installation of fans and motors for ventilating system	494.08
Expanded metal ceilings in powder magazines, in place	416.77
Repairing and painting buildings	36.78
Moving 107 granite blocks from field at rear of battery to front of battery	100.89
Time allowed employees for legal holidays	130.53
Superintendence and office expenses	1,462.77
Total	7,785.37

Amount expended to June 30, 1899	$205,894.66
Amount expended during fiscal year	11,880.75
Outstanding liabilities to June 30, 1900	62.29
Total cost of work to June 30, 1900	217,837.70
Total allotment, including transfer from allotment for work at other points	217,843.83
Expenditure and liabilities to June 30, 1900	217,837.70
Balance available July 1, 1900	6.13

Money statement.

July 1, 1899, balance unexpended	$11,949.17
July 30, 1900, amount expended during fiscal year	11,880.75
July 1, 1900, balance unexpended	68.42
July 1, 1900, outstanding liabilities	62.29
July 1, 1900, balance available	6.13

Emplacements for two 12-inch B. L. rifles.—The approved project under which these emplacements were constructed and a detailed account of the progress of the work are contained in the Annual Reports of the Chief of Engineers for 1898, pages 653 and 654, and for 1899, pages 797 to 800. These emplacements had been completed in all details, except the mounting of the guns and carriages, and had been turned over to the artillery on January 12, 1899.

The two 12-inch B. L. rifles, Nos. 37 and 38, model of 1888, had been received on July 23, 1898, and the two 12-inch nondisappearing gun carriages, Nos. 21 and 22 (Morgan Engineering Company), had been received on April 4 and May 1, 1899, respectively. The Chief of Engineers had, on May 27, 1899, allotted the sum of $1,500 from the appropriation for "Gun and Mortar Batteries," act of May 7, 1898, for the purpose of mounting the guns and carriages, and the work of mounting carriage No. 21 on emplacement No. 1 had begun on June 1, 1899. The bedplate had been set and the racer and top carriage had been hauled up on the platform ready for assembling, but on account of defects discovered in the roller path of the bedplates and in the rollers and pintle-bearing surfaces of both carriages, work had been discontinued on June 17, and orders for repairing the defects and continuing the work had not been received at the end of the fiscal year; $403.24 had been expended on this work.

Orders were received on July 5, 1899, for a machinist of the Engineer Department to make the necessary repairs, which consisted in smoothing up irregular cuts about one-thirty-second-inch deep in the surface of the roller paths and of the rollers and pintle-bearing surfaces, caused by steel chips or borings which had been left on these surfaces during the shop test. These repairs were authorized by the Ordnance Department, and the cost, $17.51, was paid for by the Morgan Engineering Company. The inner edges of the flanges on the traversing rollers of both carriages, which had been left sharp instead of rouud, cut into the roller path. This edge was rounded off on each roller by an engineer machinist, by authority of the Ordnance Department, and the cost of this work, $13.33, was paid by the Ordnance Department.

The work of mounting was continued and completed as follows:

Emplacement No. 1, right flank: Nondisappearing carriage No. 21, model 1892, mounted July 10, 1899; 12-inch rifle No. 37, model 1888, mounted July 15, 1899.

Emplacement No. 4, left flank: Nondisappearing carriage No. 22, model 1892, mounted July 24, 1899; 12-inch rifle No. 38, model 1888, mounted August 4, 1899.

The work of mounting these guns and carriages was, in addition to the delay on account of the defects in the carriages, delayed by the rigging gang having to unload and remove from the wharf one 12-inch gun and one 12-inch carriage, in addition to moving two large derricks in use on the work.

Additional defects were found in these carriages as the mounting progressed, as follows:

The filling pieces, 2.2 inches by 3 inches for the dust guard of No. 21, did not fit the racer, being open about three-sixteenths inch in places; the heads of tap bolts, 2 inches by 5½ inches, 20 on each carriage, securing the guide hooks to the racers, were not faced under the heads, and the heads were crooked or eccentric in many cases, and the castings were only roughly faced for the bolt heads to seat; the brass bushings on the pinion shaft No. 21 were found to be so loose that they turned around with the shaft; the part of the pistons which are outside the cylinders when the gun is in battery were found to have been left rough filed instead of polished. All of these defects were repaired by the engineer machinist, with the exception of the defects in the pistons of No. 22, which were found to be so rough that to polish them would reduce the diameter about one-thirtieth inch over a length of about 3 feet. These repairs were authorized by the Ordnance Department and the cost, $26.99, was paid by the Morgan Engineering Company.

The side ladders (two on each carriage) on the rear platform were not long enough for these particular platforms, the bottom step being 38 inches above the platform. New extension pieces were furnished by the Ordnance Department, which were put in place by the engineer machinist, the cost of which, $10.82, was paid by the Ordnance Department.

The timber used for trestle and blocking was removed, and the roadway in the rear and the earth embankment on the front of the emplacements up which the guns were hauled were repaired and the emplacements cleaned up, completing the work on August 11, 1899.

The total cost of mounting the guns and carriages was $1,208.58.

Care and operation of electric light and power plant, etc.—Under an allotment of $1,550 made by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, the electric plant of the 8-inch and 12-inch battery was cared for during the fiscal year by a skilled mechanic of the classified service, at a compensation of $75 per month.

Some necessary repairs were made to the plant, and tools, oils, lamps, and covers for the dynamos were purchased for repairs and maintenance. Necessary repairs were made to the wharf and railroad transfer bridge, and the piles were covered with sheet steel for protection against ice. The I-beams, trolley rails, doors, and other interior ironwork of the mortar battery were painted with superior graphite paint.

Repairs to earthen slopes of the mortar battery and of the 8-inch and 12-inch battery.—On April 6, 1900, the sum of $310 was allotted by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to be applied to repairing the gullying in the earthen slopes of the mortar battery and of the 8-inch and 12-inch battery. This work was completed in May, 1900, and the entire allotment was expended.

Construction of tide gauges and changing the position of range-finder station.—On April 6, 1900, the sum of $25 was allotted by the Chief of Engineers from the appropriation for "Gun and Mortar Batteries," for installation of range and position finders, act of July 7, 1898, to be applied to the construction of tide gauges and to change the position of the north station for type B depression range finder, which was hidden by the mortar battery. This work was completed in April, 1900, and the entire allotment was expended.

For necessary repairs, for engineer electric plant for six months, and storage battery assistant for twelve months.—On June 8, 1900, the sum of $1,500 was allotted by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, to be applied to necessary repairs, to the payment of a skilled mechanic for the care and operation of the electric plant for six months, and a storage battery assistant for twelve months.

The following table shows the expenditure on the work of preservation and repair of fortifications during the fiscal year:

Services of steam engineer for 12 months	$898.50
Repairs to transfer bridge and wharf	411.31
Painting interior ironwork of mortar battery	36.28
Purchase of tools and supplies	142.84
Repairs to electric plant	56.13
Repairing earthen slopes of the mortar battery and of the 8-inch and 12-inch battery	310.00
Construction of tide gauges and changing position of range-finder station	25.00
Total	1,880.06

Emplacements for two 5-inch rapid-firing guns.—On October 5, 1899, the Chief of Engineers allotted the sum of $15,900 from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, to be applied to the construction of emplacements for two 5-inch rapid-fire guns, segmental wire wound, to be located between the river and the mortar battery.

During the winter the locomotive which had been used for the construction of the 8-inch and 12-inch and mortar batteries was repaired, new tubes being put in the boiler, new crank pin brasses fitted, and other repairs necessary to put it in working condition made.

A large derrick, hoisting engine and boiler, about 10,000 feet of miscellaneous lumber, concrete cars, 700 barrels of Rosendale cement, and other materials were transferred.

The quantity of concrete to be placed being so small, a concrete mixing plant having bins with a capacity of only 30 cubic yards of small broken stone and 15 cubic yards of sand was erected. The small broken stone is delivered on railroad cars brought on car floats to the transfer slip at the wharf, and the stone is shoveled direct from the cars into the bin as needed, so no large storage capacity is required.

The excavation for the foundations of the battery was completed, 380 cubic yards of mud, clay, and sand being removed and placed so as to form part of the embankment.

Concrete construction was begun on April 28, 1900, and at the end of the fiscal year 384 cubic yards of Rosendale concrete, 1 : 2 : 5, and 925 cubic yards of Portland concrete in the proportions of 1 : 6 : 15, had been placed, out of a total of 1,580 cubic yards estimated for the entire battery.

The masonry of the south emplacement has been completed, including the pavement of the superior slope, and that of the north emplacement to the level of the platform. The anchor bolts are set in both platforms. No wing walls or pavements have been constructed.

The ceilings of the magazines are constructed of steel I-beams placed 2 feet apart and built in between with flat arches of 6-inch hollow tile, and the side walls are faced with 2-inch tile furring, having an air space between it and the wall behind. The tile and furring has not yet been plastered. The walls of the magazines coming in contact with the earth embankment are waterproofed with paraffine paint No. 3 and coal tar.

Four thousand eight hundred and sixty-four cubic yards of sand have been placed for filling in the sand cores under the magazines and platforms and in the embankment on the front, of which 2,475 cubic yards were purchased sand and 2,389 cubic yards were taken from the parapet of the old earthen battery.

Contracts for construction materials were awarded as follows:

With the Charles Warner Company, Wilmington, Del., dated January 27, 1900, and approved February 12, 1900, for about 900 cubic yards of washed sand, at 28 cents per cubic yard, and 6,000 cubic yards of unwashed sand, at 22 cents per cubic yard.

With the Brandywine Granite Company, Wilmington, Del., dated January 27, 1900, and approved February 16, 1900. for about 1,600 cubic yards of small broken stone, at $1.56 per cubic yard.

With Cyrus Borgner, trading as Borgner Cement Company, Philadelphia, Pa., dated April 14, 1900, and approved April 21, 1900, for about 600 barrels of Lehigh brand American Portland cement, at $2.26 per barrel. This contract was satisfactorily completed on May 6, 1900, 600 barrels having been delivered under it.

With William J. Donaldson, Philadelphia, Pa., dated April 30, 1900, and approved May 12, 1900, for about 1,400 barrels Alpha brand American Portland cement, of which about 1,000 barrels are to be delivered, at $2.21 per barrel.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended from allotment for mounting guns and carriages		$1,500.00
April 6, 1900, allotted from act of July 7, 1898, for installation of range and position finders		25.00
October 5, 1899, allotted from act of July 7, 1898, for emplacements for rapid-fire guns		15,900.00
		17,425.00
June 30, 1900, expended during fiscal year	$9,760.37	
Redeposited to credit of appropriation balance allotment for mounting guns and carriages	291.42	
		10,051.79
July 1, 1900, balance unexpended		7,373.21
July 1, 1900, outstanding liabilities	3,497.24	
July 1, 1900, covered by existing contracts	1,943.43	
		5,440.67
July 1, 1900, balance available for application to emplacements for rapid-fire guns		1,932.54

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$1,550.00
April 6, 1900, allotted from act of March 3, 1899	310.00
June 8, 1900, allotted from act of May 25, 1900	1,500.00
	3,360.00
June 30, 1900, amount expended during fiscal year	1,855.06
July 1, 1900, balance unexpended	1,504.94
July 1, 1900, outstanding liabilities	3.65
July 1, 1900, balance available	1,501.29

For abstracts of proposals received and opened during the fiscal year, see under head of emplacements for 5-inch rapid-fire guns, preceding.

List of all contracts in force, with names of contractors, date of approval, of beginning work, and expiration.

1. With Charles Warner Company, of Wilmington, Del., dated January 27, and approved February 12, 1900, for furnishing and delivering about 900 cubic yards washed sand, at 28 cents per cubic yard, and 6,000 cubic yards unwashed sand, at 22 cents per cubic yard; first delivery of washed sand to be made in April, 1900, and thereafter deliveries to be made at the rate of about 150 cubic yards per week until completion of contract; first delivery of unwashed sand to be made in May, 1900,

and thereafter deliveries to be made at the rate of about 250 cubic yards per week until completion of contract.

2. With The Brandywine Granite Company, of Wilmington, Del., dated January 27, and approved February 16, 1900, for furnishing and delivering about 1,600 cubic yards small broken stone, at $1.56 per cubic yard; times at which deliveries are to be made until completion of the contract to be determined by the Engineer Officer in charge.

Preservation and repair of submarine mining material.—On July 27, 1899, the sum of $200 was allotted by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to be applied to the care and preservation of submarine mining material.

During November, 1899, an inspection of all torpedo material on hand was made, and all the work done necessary to preserve it in first-class condition.

The Siemens searchlight was moved from its temporary shed to the torpedo shed and given a coat of paint. The General Electric searchlight with all its parts, except boiler, engine, dynamo, and switchboard, was also taken to the torpedo shed and stored. The ammeter and voltmeter of the searchlight outfit were repaired by their manufacturer.

Under authority of the Chief of Engineers dated December 22, 1899, a testing set for making delicate insulation tests of torpedo cable was purchased from the allotment for "Preservation and Repair of Fortifications," act of May 7, 1898, and each cable in the cable tank was tested with the result that they were all found to be in serviceable condition.

Another careful inspection of all torpedo material was made during the month of April, 1900.

On June 8, 1900, the Chief of Engineers allotted the sum of $150, from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, to be applied to the care and preservation of submarine mining material.

Money statement.

July 27, 1899, amount allotted	$200.00
June 8, 1900, amount allotted	150.00
	350.00
June 30, 1900, amount expended during the fiscal year	155.02
July 1, 1900, balance available	194.98

Supplies for coast defense.—On June 7, 1900, the sum of $1,000 was allotted by the Chief of Engineers from the appropriation for "Supplies for Coast Defense," act of May 25, 1900, to be applied to filling such requisitions as may be duly approved by the Chief of Engineers for material for the service of the coast artillery during the fiscal year 1901.

Money statement.

June 7, 1900, amount allotted	$1,000.00
July 1, 1900, balance available	1,000.00

Repairs to river banks.—On August 2, 1899, the sum of $300 was allotted by the Chief of Engineers from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for repairs to the river banks at this locality. The banks were repaired and placed in good condition during the months of October and November, 1899, at a total cost of $186.95. An available balance of $113.05 from this allotment is held for repair of any other breaks or holes in the banks that may occur.

Money statement.

August 2, 1899, amount allotted	$300.00
June 30, 1900, amount expended during fiscal year	186.95
July 1, 1900, balance available	113.05

3 H.

DEFENSES OF BALTIMORE, MARYLAND.

Officer in charge, Lieut. Col. Oswald H. Ernst, Corps of Engineers, from April 14, 1900; assistant, Lieut. Charles W. Kutz, Corps of Engineers; the latter being in temporary charge during the first portion of the fiscal year.

Fort McHenry, Md.—This is a fort of historic interest, commenced in 1775 and rebuilt in 1794. It is almost useless as a defensive work. Operations during the fiscal year were confined to preservation and repair.

Money statement.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	1,000.00

Emplacements for one 12-inch and three 8-inch B. L. rifles on disappearing carriages.—This battery, complete and guns mounted, had been occupied by troops since April 20, 1898, but it was officially turned over to the artillery January 5, 1900. The operations of the fiscal year consisted in installing seven electric exhaust fans in the magazines by contract, building a roadway, planting trees, and making general repairs to the battery and power plant. The roadway was to have been constructed and the trees planted by contract, but it expired by limitation July 3, 1899, without anything having been done by the contractor. The work involved in the contract was then completed by the Government. A dynamo engineer was employed part of the year to care for and repair the power and electric-lighting plant. This battery has cost $136,675.23.

Money statement.

July 1, 1899, balance unexpended		$5,290.51
June 21, 1900, amount deposited to credit Treasurer United States as a repayment	$1,624.77	
June 30, 1900, amount expended during fiscal year	3,665.74	
		5,290.51

Abstract of proposals for furnishing and installing seven electric exhaust fans, opened at Baltimore, Md., at noon of July 29, 1899.

No.	Name and address of bidder.	Amount.
1	McCay Engineering Co., Baltimore, Md	$1,485.00
2	Glenn & Morfit, Baltimore, Md	2,286.20
3	Morton, Reed & Co., Baltimore, Md	1,650.00

Contract in force during the fiscal year.

With Morton, Reed & Co., for installing electric exhaust fans, dated August 26, 1899, approved September 9, 1899, commenced September, 1899, and completed December 31, 1899.

Emplacements for two 4.7-inch rapid-fire guns.—This battery was complete and guns mounted at the beginning of the fiscal year, and the only operations since have been necessary repairs to the electric-lighting plant and slopes with funds from the appropriation for "Preservation and Repair of Fortifications." It was officially turned over to the artillery January 5, 1900.

Emplacements for two 15-pounder rapid-fire guns.—These were nearly finished at the close of the last fiscal year. The earth fill of the parapet was completed during this fiscal year, and the minor details of the battery finished, but no guns or mounts are on hand. It was turned over to the artillery May 8, 1900. The total cost of the battery was $6,860.

Money statement.

July 1, 1899, balance unexpended	$2,410.01	
August 18, 1899, amount transferred from another allotment	300.00	
		$2,710.01
June 30, 1900, amount expended during fiscal year		2,710.01

Contracts in force during the fiscal year.

With the Standard Supply and Equipment Company for ironwork, approved April 24, 1899, commenced in May, 1899, and completed July 1, 1899.

With the Schwind Quarry Company for stone, approved April 7, 1899, commenced in May, 1899, and completed October 17, 1899.

The above contracts were for materials for emplacements for six 15-pounder rapid-fire guns, emplacements for two 6-inch rapid-fire guns, and for a mining casemate and cable tank.

Sea walls and embankments.—The reservation containing the foregoing batteries has been protected from encroachment of the Patapsco River by building a sea wall and embankment and planting trees. The work was to be done by contract, but the contract expired by limitation July 3, 1899, with only a portion of the wall finished, and the United States completed the work involved in the contract during the fiscal year. The wall and supporting fill extends all around the shore line of the reservation. The wall is built of rubble masonry 4 feet in height, 4 feet wide at base, and 2 feet at top, laid dry, except the top course, which was laid in cement mortar. It rests on a riprap foundation. The area between the wall and the bluffs was filled in, the bluffs graded, and top soil put on and seeded. Grass gutters were made around the upper edge of the bluffs and at intervals down the embankments. Trees were planted along the line of the sea wall and on the embankments.

Money statement.

July 1, 1899, balance unexpended		$14,614.42
September 11, 1899, transferred to another allotment	$5,000.00	
June 30, 1900, amount expended during fiscal year	9,614.42	
		14,614.42

Contract in force during the fiscal year.

With R. P. McCormick for building sea walls and embankments, dated September 19, 1898, approved September 28, 1898, commenced in October, 1898, and expired by limitation July 3, 1899. This contract also applied to another reservation and to roadways at two batteries.

Preservation and repair of fortifications.—All the batteries and electric-lighting and power plants on the above reservation were repaired from funds from the appropriation for "Preservation and Repair of Fortifications," and supplies furnished the artillery for the power plants.

Money statement.

July 1, 1899, balance unexpended	$1,953.16	
May 25, 1900, allotted	1,000.00	
		$2,953.16
June 30, 1900, amount expended during fiscal year		1,953.16
July 1, 1900, balance available		1,000.00

Mining casemate.—Plans for constructing a mining casemate at this reservation at an estimated cost of $9,550 were submitted April 28, 1900, and were approved May 1, 1900, but no funds were available for commencing the work, and no allotment has been made.

Emplacements for two 12-inch B. L. rifles on nondisappearing carriages.—These were complete and carriages mounted at the close of the last fiscal year. During this fiscal year the guns were mounted, and two shots were fired to test the stability of the platforms. This battery will be turned over to the artillery July 5, 1900. Repairs were made to the earth parapet and electric-lighting and power plant with funds from the appropriation for "Preservation and Repair of Fortifications." The total cost of the battery, including mounting carriages and guns, was $82,647.29.

Money statement.

July 1, 1899, balance unexpended		$2,164.52
June 12, 1900, transferred to another allotment	$289.71	
June 30, 1900, amount expended during fiscal year	1,874.81	
		2,164.52

Emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts.—These emplacements were complete at the beginning of the fiscal year, except a small amount of concrete in the platforms. During the fiscal year the grounds in the rear have been graded, covered with top soil, and seeded, a flag walk built, and the cylinder of one carriage set in concrete. No complete carriage or guns are on hand.

Money statements.

TWO EMPLACEMENTS FOR 5-INCH RAPID FIRE GUNS.

July 1, 1899, balance unexpended	$1,158.78
June 30, 1900, amount expended during fiscal year	1,158.78

MOUNTING TWO 5-INCH GUN CARRIAGES.

June 12, 1900, amount transferred from another allotment	$289.71
June 30, 1900, outstanding liabilities	100.00
July 1, 1900, balance available	189.71

Emplacements for two 15-pounder rapid-fire guns.—At the beginning of the fiscal year these emplacements were completed except an iron stairway and some minor details. During the year the stairway and rail have been put in, doors hung, and the grounds back of the battery graded, covered with top soil and seeded. Flag walks were placed in rear of the battery. No guns or mounts are on hand. The battery without armament has cost $8,706.52.

Money statement.

July 1, 1899, balance unexpended	$1,861.52
June 30, 1900, amount expended during the fiscal year	1,861.52

Remodeling old work.—The site of the three foregoing batteries was partially remodeled by removing a portion of the old masonry above the crest line of the modern batteries to make it conform, both in appearance and utility, to the modern emplacements. The old masonry removed was placed as riprap around the foundations. This work of remodeling was commenced during the fiscal year, but has not been completed. An additional allotment of $1,600 to finish these operations was made June 20, 1900.

Money statement.

Allotments	$11,200.00
June 30, 1900, amount expended during fiscal year	8,147.88
June 30, 1900, balance unexpended	3,052.12
June 30, 1900, outstanding liabilities	500.00
July 1, 1900, balance available	2,552.12

Preservation and repair of fortifications.—The batteries and the electric-lighting and power plant at this post have been repaired during the fiscal year with funds from the appropriation for "Preservation and Repair of Fortifications." Also supplies have been furnished for those plants, which were operated part of the year by a dynamo engineer in the employ of the Engineer Department, and the balance by an electrician sergeant placed under the directions of the engineer officer in charge, the artillery receipting for the supplies.

Money statement.

July 1, 1899, balance unexpended	$1,829.90
June 6, 1900, allotted	1,000.00
	2,829.90
July 30, 1900, amount expended during fiscal year	1,829.90
June 30, 1900, balance unexpended	1,000.00
June 30, 1900, outstanding liabilities	165.00
July 1, 1900, balance available	835.00

Battery for eight 12-inch B. L. mortars.—This was complete with its armament at the beginning of the fiscal year, and occupied by troops, but was not officially turned over to the artillery until January 8, 1900. The operations for the year have been confined to repair of the work and its power and electric-lighting plant with funds from the appropriation for "Preservation and Repair of Fortifications."

Two emplacements for 12-inch B. L. rifles on disappearing carriages.—This battery was complete with its armament at the close of the last fiscal year. It was officially turned over to the artillery July 5, 1899. The operations of the present fiscal year were confined to necessary repairs with funds derived from the appropriation for "Preservation and Repair of Fortifications," and clearing up and storing plant after gun mounting with funds allotted for mounting carriages and guns. During the year the guns were dismounted and the carriages partially so by the Engineer force to enable the Ordnance Department to correct some defects, and were again mounted, all at the expense of the Ordnance Department.

Money statement.

July 1, 1899, balance unexpended	$532.49
March 10, 1900, transferred to another allotment	419.19
	113.30
June 30, 1900, amount expended during fiscal year	113.30

Emplacements for two 5-inch rapid-fire guns.—With the exception of the platforms, these emplacements were complete at the close of the last fiscal year. During the present year the carriages were received and mounted and the platforms finished. A roadway leading from other parts of the reservation to the battery was also built and trees planted. As soon as the ammunition hoists are modified to accommodate a change made in the ammunition the battery will be ready to turn over to the artillery. No guns are on hand. The battery cost $17,400.

Money statements.

5-INCH GUN BATTERY.

July 1, 1899, balance unexpended	$1,868.70
June 30, 1900, amount expended during fiscal year	1,868.70

MOUNTING 5-INCH GUN CARRIAGES.

April 25, 1900, allotted	$400.00
June 30, 1900, amount expended during fiscal year	400.00

Emplacements for two 15-pounder rapid-fire guns.—At the beginning of the fiscal year these were complete except the earth parapet and stairway. The parapet was filled in and sodded during the year, and the stairway and rail erected. There was considerable depression in the grounds surrounding this battery, which was filled in, graded, covered with top soil, and seeded. No guns or mounts are on hand. The battery was turned over to the artillery May 8, 1900. The battery has cost $10,445.

Money statement.

July 1, 1899, balance unexpended	$5,210.06
August 18 and October 28, 1899 transferred to other allotments	900.00
	4,310.06
June 30, 1900, amount expended during fiscal year	4,310.06

Emplacements for two 6-inch B. L. rifles on disappearing carriages.—Only a partial excavation of the foundations for this battery was finished at the close of the last fiscal year, and the battery has been practically constructed and carriages mounted during the present year. The emplacements follow the type plans, except that the magazines and shell rooms of both are placed beneath the central traverse and are united by a passageway for the purpose of securing a natural circulation of air, thereby reducing the condensation of moisture.

The materials were purchased by contract and the work done by hired labor. The grounds surrounding the battery were graded, fertilized, and seeded. The emplacements have been wired and power is to be furnished from the plant at the mortar battery on the same reservation, although the connections have not yet been made. Blocks and trolleys remain to be furnished and arrangements are now in progress to secure them. The battery was built with the plant already on hand and used in the construction of the other batteries at the same site. This battery was turned over to the artillery May 8, 1900. No guns are on hand. The details of the cost of the battery are as follows:

2 amunition hoists placed		$1,645.35
4 ammunition cranes placed		106.30
400 square yards asphalt placed, at $0.58		231.98
78,410 brick, common red, placed, at $\$19.69\frac{2}{10}$		1,543.94
6,498 brick, gray, pressed, placed, at $\$42.53\frac{92}{100}$		276.42
67,217 brick, paving, placed, at $20.89\frac{2}{10}$		1,404.30
6,600 brick, hollow, placed, at $18.07		119.26
28,253 pounds beams, I, placed, at $\$0.04\frac{12}{100}$		1,164.08
2,900 cubic yards concrete, natural, placed, at $5.23	$15,167.00	
250 cubic yards concrete, granolithic, placed, at $12	3,000.00	
184 cubic yards concrete, Portland, placed, at $\$6.94\frac{63}{100}$	1,280.12	
		19,447.12
536 linear feet drain pipe placed, at $\$0.11\frac{96}{100}$		64.08
323 cubic yards rubble for drains placed, at $\$1.73\frac{96}{100}$		561.89
1,200 feet B. M. lumber in doors and shutters placed, at $153.04		183.65
3,600 cubic yards excavation placed, at $39.25		1,413.00
Electric lighting and speaking tube service placed		307.33
13 cubic yards granite coping placed, at $\$72.12\frac{15}{100}$		937.58
682 pounds hinges and gudgeons placed, at $\$0.25\frac{3}{100}$		170.75
3,850 square feet corrugated iron placed, at $\$0.11\frac{88}{100}$		457.38
15 locks and fittings placed		137.06
1,320 pounds manhole frames and covers placed, at $0.05		66.00
6 ring bolts, 4 ladders, placed		102.88
450 cubic yards soil placed, at $\$0.37\frac{1}{2}$		168.75
1,562 square yards sod placed, at $\$0.23\frac{64}{100}$		369.26
6,895 pounds stairways and railings, at $\$0.09\frac{5}{100}$		624.21
302 linear feet trolley rail, at $\$0.75\frac{55}{100}$		228.15
Superintendence, office expenses, steam tender, etc		3,395.47
Grading, fertilizing, seeding, and clearing up grounds, and cleaning up and storing plant		2,807.72
		37,933.91

Money statement.

July 1, 1899, balance unexpended	$46,475.86
Transferred to other allotments	8,000.00
	38,475.86
June 30, 1900, amount expended during fiscal year	37,109.77
June 30, 1900, balance unexpended	1,366.09
June 30, 1900, outstanding liabilities	300.00
July 1, 1900, balance available	1,066.09

Contracts in force during the fiscal year.

With Matthew W. Adams for sand, dated June 23, 1899, approved July 5, 1899, commenced in June, 1899, and completed August 17, 1899.

With the National Building Supply Company for American Rosedale cement, dated June 28, 1899, approved July 12, 1899, commenced in June, 1899, and completed August 1, 1899.

With B. Wallis & Co. for Portland cement, dated June 28, 1899, approved July 12, 1899, commenced in July, 1899, and completed August 1, 1899.

With the Baltimore High Grade Brick Company for bricks, dated June 23, 1899, approved July 12, 1899, commenced in July, 1899, and completed September 1, 1899.

With McClenahan & Brother Granite Company for stone, dated June 28, 1899, approved July 20, 1899, commenced in June, 1899, and completed August 31, 1899.

Emplacements for two 15-pounder rapid-fire guns.—An allotment of $10,000 was made June 20, 1900, from the appropriation for "Gun and Mortar Batteries," act of May 25, 1900, for building the battery and a roadway to it. Only the preliminary steps have been taken and no work on the battery has yet been done.

Money statement.

June 20, 1900, allotted	$10,000.00
July 1, 1900, balance available	10,000.00

Mining casemate.—There yet remains to be done at the beginning of the fiscal year sodding, doors, shutters, a telephone conduit to the storehouse, and grading the surrounding grounds. During the year the grounds have been graded, fertilized and seeded between the casemate and storehouse, a conduit partially constructed, and the doors and shutters put in. The casemate is practically completed.

Money statement.

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended	$3,810.01
June 30, 1900, amount expended during fiscal year	2,325.37
June 30, 1900, balance unexpended	1,484.64
June 30, 1900, outstanding liabilities	400.00
July 1, 1900, balance available	1,084.64

Storehouse for torpedo material.—During the fiscal year the storehouse was built, the foundations and concrete floor being put in by hired labor and the superstructure by contract. The cost was $5,000.

Money statement.

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended	$4,923.25
June 30, 1900, amount expended during the fiscal year	4,923.25

Contract in force during the fiscal year.

With Albert Weber for building a storehouse, dated June 7, 1899, approved June 20, 1899, commenced in July, 1899, and completed December 4, 1899.

Cable tank.—This was complete at the beginning of the fiscal year. The operations during the year were simply the payment of outstanding liabilities.

Money statement.

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended	$345.88
June 30, 1900, amount expended during fiscal year	345.88

Sea walls and embankments.—This work is for the protection of the reservation containing the last six batteries reported upon, together with the mining casemate, storehouse, and cable tank. It was under contract up to July 3, 1899, when the contract expired by limitation. The bond paid the United States $4,871.87 excess cost to the Government in completing the unfinished work involved in the contract. Only a small portion of the sea wall was constructed, although the foundation was in when the contract expired, but the wall lacked the support which the fill in the rear would have given it. With the balance of the allotment and the amount paid by the bonding company, work was vigorously prosecuted during the fiscal year. The sea wall and embankments involved in the contract were completed. An extension of the sea wall 1,275 linear feet eastward is now in progress with the funds forfeited by the bond company, and is finished with the exception of about 55 linear feet. It is built of concrete. This 1,275 linear feet of wall lacks the support of an embankment behind it. The walls are 4 feet in height, 4 feet wide at base, and 2 on top, the wall involved in the contract being of rubble masonry, laid dry, except the top course, which is laid in cement mortar. The area between the walls and bluff, except 1,275 linear feet, is filled in, the bluff graded, fertilized, seeded, and grass gutters placed along the upper edge of of the bluff and at intervals down the embankment. Trees are planted along the wall and on the embankments. Sea walls and embankments are also urgently needed on the western face of this reservation where the encroachments of the Patapsco River are serious.

Money statement.

July 1, 1899, balance available	$11,014.25
September 11, 1899, transferred from another allotment	5,000.00
April 20, 1900, allotted (amount paid by Bond Company)	4,871.87
	20,886.12
June 30, 1900, amount expended during fiscal year	18,845.88
June 30, 1900, balance unexpended	2,040.24
June 30, 1900, outstanding liabilities	1,000.00
July 1, 1900, balance available	1,040.24

Contract in force during the fiscal year.

With R. P. McCormick, for building sea walls and embankments, dated September 19, 1898, approved September 28, 1898, commenced in October, 1898, and expired by limitation July 3, 1899.

Preservation and repair of fortifications.—The last six batteries reported upon, the mining casemate, storehouse, cable tank, and sea wall are upon a reservation which has been cared for with funds from the appropriation for "Preservation and Repair of Fortifications." The batteries, power and electric-lighting plants, and slopes have received necessary repairs during the fiscal year. Supplies for the power and electric-lighting plants have also been furnished the artillery with funds from the same appropriation.

Money statement.

July 1, 1899, balance unexpended	$2,137.62
June 6, 1900, allotted	1,500.00
	3,637.62
June 30, 1900, amount expended during fiscal year	1,500.92
June 30, 1900, balance unexpended	2,136.70
June 30, 1900, outstanding liabilities	200.00
July 1, 1900, balance available	1,936.70

Emplacements for two 6-inch B. L. Rifles on disappearing carriages.—The work was built by hired labor, the material being purchased under contract. At the beginning of the fiscal year a wharf had been constructed at the reservation by contract and railroad tracks laid from the outer end of the wharf to the site of the battery. The foundations of the battery had been excavated and riprap placed for blind drains. During the fiscal year the battery was completed except wiring and furnishing trolleys and blocks, the carriages mounted, and the battery turned over to the artillery May 8, 1900. A small power house was erected in rear of the emplacements, the grounds graded, covered with top soil, and seeded, and the reservation and property cared for by a watchman after operations ceased. Most of the plant used in construction was already on hand, but the locomotive and cars were transferred from the Wilmington, N. C., district. The emplacements follow the type plans, except that the magazines and shell rooms of both are placed beneath the central traverse and are united by a passageway for the purpose of securing a natural circulation of air, thereby reducing the condensation of moisture.

The details of the cost of the battery are as follows:

	Labor.	Material.	Total.	Cost per unit.
Office expenses, superintendence, and steam tender	$3,356.62	$557.14	$3,913.76	....
Excavation (930 cubic yards)	504.00	44.05	548.05	$$0.58\frac{93}{100}$
Track from wharf to battery (4,123 linear feet)	1,031.99	1,564.79	2,596.78	$.62\frac{98}{100}$
Small rubble masonry (341 cubic yards)	399.19	686.59	1,085.78	$3.18\frac{41}{100}$
Clearing and improving reservation	363.07	18.02	381.09	....
Iron roof beams (26,650 pounds)	398.10	698.30	1,096.40	$.04\frac{11}{100}$
Granolithic (243 cubic yards)	971.27	1,988.68	2,959.95	$12.18\frac{9}{100}$
Rosendale concrete (2,853 cubic yards, including 250 cubic yards large rubblestone)	4,809.26	8,911.48	13,720.74	$4.80\frac{92}{100}$
Portland concrete (385 cubic yards)	844.37	2,100.86	2,945.23	7.65
Hollow bricks (6,500)	42.65	115.59	158.24	$24.34\frac{46}{100}$
Brick paving (570 square yards)	558.60	516.36	1,074.96	$1.88\frac{59}{100}$
Brick masonry, gray pressed (19 cubic yards)	157.93	355.92	513.85	$27.04\frac{47}{100}$
Brick masonry, red (186 cubic yards)	1,142.60	1,282.82	2,425.42	$13.03\frac{99}{100}$
Terra-cotta pipe (drain and ventilation, 243 linear feet)	25.88	14.02	39.90	$.16\frac{42}{100}$
Ladders (4), ring bolts (6), iron gratings (2), foundation bolts (24), sewer plates (2), and speaking tubes (2 sets)	83.35	164.87	248.22	....
Doors (18), windows (2), and shutters (10)	162.82	568.49	731.31	....
Ammunition cranes (4)	11.55	100.00	111.55	$27.88\frac{75}{100}$
Cut-granite masonry (19 cubic yards)	759.78	30.91	790.69	$41.61\frac{52}{100}$
Earth fill (including 596 cubic yards top soil, 6,286 cubic yards)	1,248.50	1,046.37	2,294.87	$.36\frac{51}{100}$
Granolithic finishing (970 square yards)	481.73	....	481.73	$.49\frac{66}{100}$
Asphalt covering (410 square yards)	53.07	200.85	253.92	$.61\frac{93}{100}$
Corrugated iron (4,117 square feet)	232.74	458.41	691.15	$.16\frac{79}{100}$
Cement finish for asphalt covering (820 square yards)	80.35	147.17	227.52	$.27\frac{75}{100}$
Grading in rear of battery	129.02	104.00	233.02	....
Trolley beams (303 linear feet)	104.02	179.34	283.36	$.93\frac{52}{100}$
Sod on earth fill (1,405 square yards)	256.30	278.36	534.66	$.38\frac{5}{100}$
Sowing seed on earth fill (1,661 square yards)	54.76	4.36	59.12	$.03\frac{56}{100}$
Iron hand railings (2 sets)	10.63	30.00	40.63	$20.31\frac{50}{100}$
Building wharf (contract)	....	5,394.31	5,394.31	....
Ammunition hoists (2)	....	1,599.00	1,599.00	799.50
Iron railings and stairways (2 sets)	....	555.65	555.65	$277.82\frac{50}{100}$
Clearing up and storing plant and care of reservation after operations ceased	....	....	264.68	....
Total	18,274.15	29,716.71	48,255.54	

Money statement.

TWO EMPLACEMENTS FOR 6-INCH GUNS.

July 1, 1899, balance unexpended	$42,631.13
October 28, 1899, transferred to another allotment	1,000.00
	41,631.13
June 30, 1900, amount expended during fiscal year	40,846.67
June 30, 1900, balance unexpended	784.46
June 30, 1900, outstanding liabilities	40.00
July 1, 1900, balance available	744.46

MOUNTING TWO 6-INCH GUN CARRIAGES.

March 10, 1900, transferred from mounting two 12-inch guns	$419.19
June 30, 1900, amount expended during fiscal year	419.19

Sea walls and embankments.—Eight thousand dollars were allotted June 26, 1900, from the appropriation for "Sea Walls and Embankments," act May 25, 1900, to build about 1,492 linear feet of concrete sea wall on a riprap foundation and fill behind it, to protect the reservation containing the foregoing battery from encroachments of Patapsco River and Chesapeake Bay, which had become serious near the site of the battery. The wall is to be built 2 feet wide on top, 4 feet at base, and 5 feet in height. Preliminary arrangements are in progress, but work in the field has not commenced.

Money statement.

June 26, 1900, allotted	$8,000.00
July 1, 1900, balance available	8,000.00

Preservation and repair of fortifications.—The works on the above reservation are to receive necessary repairs with funds from the appropriation for "Preservation and Repair of Fortifications." No repairs have yet been needed.

Money statement.

June 6, 1900, allotted	$320.00
July 1, 1900, balance available	320.00

Supplies for coast defenses.—One thousand dollars were allotted June 7, 1900, from the appropriation for "Supplies for Coast Defenses," act of May 25, 1900, for filling such requisitions for supplies for the defenses of Baltimore as may be approved by the Chief of Engineers. No requisitions have yet been filled under this appropriation, those for the fiscal year having been furnished from the appropriation for "Preservation and Repair of Fortifications."

Money statement.

June 7, 1900, allotted	$1,000.00
July 1, 1900, balance available	1,000.00

Submarine mine defense.—The sum of $500 was allotted June 19, 1900, from the appropriation for "Preservation and Repair of Fortifications," act May 25, 1900, for the care and preservation of torpedo material for the defenses of Baltimore Harbor during the fiscal year 1901. Nothing has yet been expended from this allotment. During the fiscal year this torpedo material has been stored and cared for by the Engineer force engaged in the construction of coast defenses.

Money statement.

June 19, 1900, allotted	$500.00
July 1, 1900, balance available	500.00

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3 I.

DEFENSES OF WASHINGTON, DISTRICT OF COLUMBIA.

Officer in charge, Lieut. Col. Charles J. Allen, Corps of Engineers.

LEFT BANK POTOMAC RIVER.

The progress and general condition of the work at the close of the fiscal year ended June 30, 1899, were as follows:

The first battery, two 10-inch guns on disappearing carriages, L. F., model of 1894, was completed by the close of 1896. The guns were mounted in the winter of 1896–97. During the fiscal year ended June 30, 1899, an electric-light plant was installed in this battery.

The second battery for two 10-inch guns was completed and an electric-light and power plant installed in it.

One of the guns was mounted in 1897 on a disappearing carriage, L. F., model of 1894; the other was mounted in May, 1898, on a disappearing carriage, L. F., model of 1896.

The third battery for two 10-inch guns was also completed. The guns were mounted in 1898 on disappearing carriages, L. F., model of 1896.

This battery was commenced in the latter part of March, 1898, and built with funds from the appropriation of March 9, 1898, for National Defense.

Emplacements for two 4-inch Driggs-Schroeder rapid-fire guns were also completed. The guns were mounted by the early part of July, 1898.

These three 10-inch gun batteries and the two emplacements for the 4-inch rapid-fire guns, constituting a two-gun battery, were turned over to the commanding officer of the post on July 6, 1899, as required by paragraph 1486, Army Regulations, 1895.

The following work was in progress at the close of the fiscal year ended June 30, 1899:

Mortar battery, for eight 12-inch mortars on carriages, model of 1896.—Under an allotment of $113,000 made August 8, 1898, for the construction of emplacements for eight 12-inch mortars, work was commenced on August 25, 1898. By the close of the fiscal year 1899 the work was about half completed.

The following is from the report by Assistant Engineer C. A. Miner for the fiscal year ended June 30, 1900:

At the close of the fiscal year 1899 the railroad to the site had been constructed, site for battery cleared, soil stripped, excavation made, drainage system nearly completed, and the concrete work of the magazines and parapets constructed to a height of about 9 feet above the floors. Natural-cement concrete amounting to 4,478 cubic yards had been made, the lining tile of magazines and ceiling beams were in place, and 16,400 cubic yards of the earth embankment, or about 40 per cent of the whole, had been placed. The entire work of constructing the battery was about one-half completed.

During the months of July, August, and September of the present fiscal year the concrete work on the magazines and parapets was completed and the asphalt covering of magazines placed. The platforms and mortar pits were constructed mostly in

October, and the asphalt surface placed on the vertical walls. Concrete work was suspended in November and commenced again in April, 1900, after which the remaining concrete and granolithic work on the platforms and observing stations was completed, and nearly completed on the rear walk before the close of the fiscal year.

Earthwork was resumed in December, 1899, and good progress was made during the entire winter. This work was completed, excepting the soil covering, in May, 1900.

During the spring some cracks had developed in the concrete work and some settlement of the battery was noticed to be taking place. After observing this for some time it was decided to remove some of the earthwork temporarily until the settlement should have ceased and the battery reached a firm foundation. This was done in May and June. The original reference of traverses and parapet was 197. This was reduced 9 feet (to 188) in the parapet and 12 feet (to 185) in the traverses. The earth slopes of the traverses were temporarily changed from two-thirds to one-half.

Investigations were carried on during the latter part of the fiscal year to ascertain the bearing power of the substratum on which the battery rests and the nature of the substrata of the battery for 30 feet in depth. A soft clay stratum was found at a depth of 12 feet below the foundations, which is believed to account for whatever settlement has taken place. Settlement practically stopped in June.

At the close of the fiscal year the following work remained to be done on this battery:

On account of settlement the base rings will have to be taken up and releveled.

The 6-inch thickness of Portland concrete roof of the middle traverse having become shattered and slipped down under the weight of the earth cover so as to push off the coping, the earth on this traverse will have to be removed, the roof repaired, the coping rebuilt, and the earth replaced. This slipping was due to the heavy weight of the earth covering of the traverse.

The steel steps, ladders, and railing, and the ammunition conveyers have not yet been put in place; the doors have to be made and hung; the rear walk remains to be finished, the road to be graded and guttered, the mortars received and mounted, and the soil covering placed and slopes seeded. The work remaining to be done is estimated at 12 per cent of the whole.

The concrete and earthwork done on this battery was as follows:

	Total to end of fiscal year 1900.	Before fiscal year 1900.	During fiscal year 1900.
Concrete, cubic yards	10,305	4,478	5,827
Earth embankment, cubic yards	38,000	16,400	21,600
Removing earth once placed	7,600	....	7,600

The work was done by hired labor.

The distribution of the cost of labor for the past fiscal year is as follows:

Engineering and supervision	$2,318.48
Excavation and embankment, 21,600 cubic yards, at $0.265	5,717.67
Construction and maintenance of plant	1,195.13
Natural cement concrete, 4,410 cubic yards, at $0.505	2,429.49
Portland cement concrete	1,188.20
Fine Portland cement concrete, 1,417 cubic yards, total	44.13
Granolithic on mortar platforms, at $1.475 per yard	857.52
Asphalt covering	486.47
Forms for concrete	987.40
Steel beams	38.33
Bolts, nuts, and washers for platforms	132.78
Electric lighting	16.20
Hollow tiling for magazine walls and ceilings	164.34
Drainage system (main)	147.26
Leaders and ventilating pipe	10.80
Gravel backing	306.22
Roadway, gravel gutters, etc	30.73
Mounting mortars (setting base rings) and transporting to site of the battery	1,053.27
Care of property	517.47
Unloading and hauling material	1,715.17

Dismantling derricks and other machinery	$356.48
Removing earth from traverses, 7,600 cubic yards, at $0.172	1,304.28
Removing granolithic coping (center traverse)	59.01
Testing foundations of battery	34.19
Legal holidays	507.26
Total of pay roll for fiscal year 1900	21,618.28
Total pay roll previous to fiscal year 1900	23,973.16
Total expense for labor	45,591.44

Referring to the releveling of the base rings mentioned in the foregoing quotation, the settlement of one of the platforms was zero, that of two of them practically nothing, and that of five of them averaged 0.035 foot. The correction is easily made. No settlement has been observed at the right flank since June 8, and none in any of the rest of the battery since May 23.

Money statement.

July 1, 1899, balance unexpended	$64,362.30
June 30, 1900, amount expended during fiscal year	48,254.63
July 1, 1900, balance unexpended	16,107.67
July 1, 1900, outstanding liabilities	1,679.00
July 1, 1900, balance available	14,428.67

Battery for two 6-inch rapid-fire guns on disappearing carriages.—This work was commenced in June, 1899, under an allotment of $59,180 made April 26, 1899, by the Chief of Engineers.

Difficulty was experienced in the season of 1899 in obtaining material for the work. Prices had mounted and material was everywhere in demand. Efforts were made as early as June, 1899, to obtain rails for the track to the site of this battery, but without success. The effort was then made to get second-hand rails, but without success until about the latter part of October, 1899, when a lot of such rails, though 10 pounds heavier than were wanted, was obtained from a party in in Philadelphia who added a few new rails that he had to the second-hand lot, thus enabling the constructing force to lay the track, the grading and placing of ties having been done long before. The difficulty in getting other material, notably tile, was also felt. A satisfactory bid for tile was finally received in January last, but early in February notice was received from the bidder that his works had burned down and that he could not fill the order. That called for the issuance of new circulars and efforts in other directions to obtain suitable hollow, porous tile.

Three hundred and ninety-five cubic yards of Rosendale cement concrete have been laid and 3,000 cubic yards of excavation and embankment made.

Sufficient Rosendale and Portland cement has been received as well as large quantities of broken stone, pebbles, and sand. The steel beams and other materials are now on hand. Some sand, tiles, etc., remain to be supplied. The anchor bolts were delivered without the tests required by specifications having been made. The test bolts were sent by this office to Riehlé, at Philadelphia, for test, the expense to be deducted from the payment to the manufacturer of the bolts.

The work for this battery, taking into account the receipt of material, is, at the close of this fiscal year ending June 30, 1900, about 25 per cent done.

Money statement.

July 1, 1899, balance unexpended	$59,123.78
June 30, 1900, amount expended during fiscal year	34,038.43
July 1, 1900, balance unexpended	25,085.35
July 1, 1900, outstanding liabilities	2,677.00
July 1, 1900, balance available	22,408.35

Battery for two 15-pounder rapid-fire guns.—An allotment of $9,500 was made December 28, 1898, for emplacements for two 15-pounder rapid-fire guns. By the close of the fiscal year 1899 a wagon road to the site of the emplacements which were to constitute a 2-gun battery had been built and considerable progress in construction made. The work was about 45 per cent done. By October, 1899, the work was about completed excepting the construction of the gun platforms, which can not be undertaken until the gun mounts arrive.

The iron ladders, railings, etc., were arranged for in June, 1900. They remain to be set up.

Money statement.

July 1, 1899, balance unexpended	$5,295.14
June 30, 1900, amount expended during fiscal year	3,385.16
July 1, 1900, balance unexpended	1,909.98
July 1, 1900, outstanding liabilities	10.00
July 1, 1900, balance available	1,899.98

Battery commanders' stations.—Under allotments of $12,206 made in June and July, 1899, work was commenced in September of that year on battery commanders' stations at the 10-inch batteries.

Excavation was made, materials hauled to site (by wagons) from railroad, forms constructed, and concrete work begun. The 90-pound T-rail was removed from the experimental parapet and used for floor beams. When concrete construction had to be closed, on account of cold weather, the stations had all been constructed to the lower surface of the floors, pedestals completed, and earth embankment at one of the batteries completed. Work was resumed in April, 1900, and at the close of the fiscal year the concrete work was finished, floors constructed, doors and casings nearly completed but not hung, soil covering at this battery placed, and slopes seeded. The iron roofs, railing, ladders, and steps are yet to be delivered by contract.

The work is about three-fifths done.

Concrete was mixed by hand and placed by wheelbarrows at one of the batteries and up to the floor level at the other two; but a small derrick was improvised to hoist and place materials above the floor levels in the latter two stations. Materials were hauled by carts and wagons from the nearest points of the railroad.

Money statement.

July 1, 1899, balance unexpended	$3,692.00
Allotted during the year	8,514.00
	12,206.00
June 30, 1900, amount expended during fiscal year	4,585.07
July 1, 1900, balance unexpended	7,620.93
July 1, 1900, outstanding liabilities	184.00
July 1, 1900, balance available	7,436.93

Extension to mining casemate.—An allotment of $4,500 was made September 20, 1898, for construction of an extension to the mining casemate which had been built about 1891.

Assistant Engineer Miner reports this work as follows in his report of operations for the past fiscal year:

> It consists of a room 13 feet 10 inches by 16 feet 10 inches, inside dimensions, with a double wall of concrete each 2 feet thick with an open air space of 6 inches between, each wall having its outer vertical faces coated with asphalt. An asphalt course was placed above the room sloping and extending to the air space, and there was placed also an asphalt waterproof course below the floor. The ceiling of the room is made of hollow arch tile between the steel I-beams, and the vertical walls are covered with a wainscoting of wood with an air space at the back. This air space opens into a large brick ventilating chimney, and besides this there are 8-inch cast-iron ventilation pipes extending from the ceiling to the open air above.
>
> Work was commenced on May 16, 1899. By the commencement of the fiscal year 1900 about 1,500 cubic yards, or five-sixths of the total excavation, had been made, it being necessary to shore the banks continually on account of the soft, springy condition of the earth.
>
> The excavation was completed in July, 1899, the total amounting to 1,750 cubic yards. The concrete foundations were laid in August and the walls constructed as rapidly as practicable, the inner wall being kept somewhat in advance of the outer. The concrete was mixed by hand and conveyed in wheelbarrows. The drainage system was constructed and the waterproof coatings of asphalt applied in the early autumn. In October and November the back filling of earth, amounting to 2,074 cubic yards, was placed; the wood linings of casemate were built; a lining of porous, hollow tile placed in the old casemate; * * * floor constructed; covers built for ventilators; gutters made to protect the new slopes from washing out during rains, and much miscellaneous work was done.
>
> The only work done since that was in May and June, 1900, when the slopes were covered with a coat of soil and seeded, * * *.
>
> The work was done by hired labor and is complete.

Money statement.

July 1, 1899, balance unexpended	$3,597.94
June 30, 1900, amount expended during fiscal year	3,436.69
July 1, 1900, balance unexpended	161.25
July 1, 1900, outstanding liabilities	49.00
July 1, 1900, balance available	112.25

Experimental parapets.—These were completed by the early part of June, 1898, and tested in June, 1899.

The only work done in connection with these parapets during the past fiscal year and paid for from the allotment for them was as follows:

Removing loose concrete in order to trace the path of the projectile; cleaning, oiling, and caring for the 10-inch gun and nondisappearing carriage. Removing and packing the breech mechanism in order that it might be shipped to Watervliet Arsenal for alteration. This mechanism was received back in May, last.

Money statement.

July 1, 1899, balance unexpended	$496.64
June 30, 1900, amount expended during fiscal year	96.41
July 1, 1900, balance unexpended and available	400.23

Care, preservation, and repair of fortifications.—Under this head repairs were made to the searchlight engine house, to running the engine in the interest of its preservation, and to repairing officers' quarters in the old fort and which had received some injury from the experimental firing. A lift was repaired at one of the 10-inch batteries. Submarie mine cables were tested and cared for. The semiannual inspections of submarine mine material were made; slopes were seeded at one of the 10-inch batteries; concrete superior slopes of batteries were colored; searchlight outfits were cleaned; gutters and roadways of fortifications were repaired; the wharf received some new fender piles and timbers, and some other small miscellaneous work was done.

Money statement.

July 1, 1899, balance unexpended	$1,954.75
Allotted during the year	2,892.00
	4,846.75
June 30, 1900, amount expended during fiscal year	1,605.13
July 1, 1900, balance unexpended	3,241.62
July 1, 1900, outstanding liabilities	503.00
July 1, 1900, balance available	2,738.62

Supplies for coast defenses.—An allotment of $600 was made June 7, 1900, from the appropriation for "Supplies for Coast Defenses," act of May 25, 1900, for furnishing material for the service of the coast artillery in this engineer district under the provisions of General Orders, No. 66, Adjutant-General's Office, 1900. No purchases have yet been made under this allotment.

Money statement.

Amount of allotment (and available)	$600.00

Location of type A range and position finders.—The allotment under the above title was made to cover the expense of taking some accurate horizontal measurements with a view to location of the points for which the structures for these range and position finders are to be put up at two sites, and for preparation of blue prints for use of the Board on Range and Position Finders. Nothing was done during the fiscal year ended June 30, 1900, no further information having been called for by the Board.

The unexpended balance of funds was deposited in the Treasury June 30, 1900, and will not be needed for the purpose for which the allotment was made.

Money statement.

July 1, 1899, balance unexpended	$44.13
July 1, 1900, balance unexpended and available	44.13

All the work at this locality was by hired labor.

Abstract of proposals for furnishing Rosendale cement for use in construction of 6-inch rapid-fire battery, received in response to advertisement dated June 22, 1899, and opened July 12, 1899, by Lieut. Col. Charles J. Allen, Corps of Engineers, U. S. Army.

No.	Name and address of bidder.	Brand.	Price per barrel (5,000 barrels).	Total.	Rate of delivery.
1	James H. McGill, Washington, D. C.	Beach's	$1.12½	$5,625.00	Not less than 3,000 barrels within 25 days, and remainder within 40 days after notice of approval of contract.
2	The Lawrenceville Cement Co., New York, N. Y.	Beach's	1.14	5,700.00	Do.
3	New York and Rosendale Cement Co., New York, N. Y.	Brooklyn bridge	1.15	5,750.00	Do.
4	The Lawrence Cement Co., New York, N. Y.	Hoffman	1.15	5,750.00	Do.

Abstract of proposals for iron and steel roofs, stairs, railings, ladders, ammunition lifts and cranes, tram rails, trolleys, and hoists, received in response to advertisement dated May 4, 1900, and opened at 12 m., June 4, 1900, by Lieut. Col. Charles J. Allen, Corps of Engineers, U. S. A.

No.	Name and address of bidder.	Class A. *a*		Class B. *a*			
				Stairs.			
		4 roofs (each).	Total.	Flight No. 1.	Flight No. 2.	Flight No. 3.	Flight No. 4.
2	New Jersey Foundry and Machine Co., 26 Cortlandt street, New York, N. Y.	$1,875	$5,500	$235.00	$217.00	$265.00	$120.00
	Alternative plan			177.50	191.00	217.50	115.00
3	The Stewart Iron Works, Cincinnati, Ohio			436.00	455.00	445.00	264.00
	Alternative plan			429.00	486.00	420.00	264.00
4	The North Penn Iron Co., North Penn Junction, Philadelphia, Pa	430	1,720	257.00	257.00	239.00	122.00
	Alternative plan			233.00	233.00	222.00	110.00
5	Whitehead & Kales, Detroit, Mich	395	1,580	257.00	244.00	270.00	146.00
	Alternative plan			205.00	189.00	228.00	124.00
6	Robt. S. Bishop, 31 Broadway, New York, N. Y.	1,025	4,100	250.00	235.00	280.00	145.00
	Alternative plan			180.00	192.00	285.00	130.00
8	Stacy B. Opdyke, jr., 1222 Belmont avenue, Philadelphia, Pa	815	3,260	292.00	270.00	423.00	176.00
	Alternative plan			290.00	255.00	425.00	178.00
9	Wm. P. Greenlie, Robt. S. Wyatt, David Greenlie, 499 Water street, New York, N. Y	1,022	4,088	245.00	237.00	274.00	144.00
	Alternative plan			180.00	192.00	233.00	128.00
12	The Lawrence Bolt and Iron Works of Baltimore City, rear 422 East Pratt street, Baltimore, Md	460	1,840	269.09	254.09	318.84	170.43
	Alternative plan			220.00	210.00	270.00	146.00
13	Charles E. Ellicott, trading as Ellicott Machine Co., Baltimore, Md	1,120	4,480	247.00	247.00	297.00	192.00
	Alternative plan			217.00	217.00	252.00	162.00
14	Snare & Triest, incorporated, 39 Cortlandt street, New York, N. Y	505	2,020	300.00	290.00	320.00	200.00
	Alternative plan			280.00	270.00	310.00	190.00

No.	Name and address of bidder.	Class B *a*—Continued.				
		Stairs—Continued.				
		Flight No. 5.	Flight No. 6.	Flight No. 7.	Flight No. 8.	Total.
2	New Jersey Foundry and Machine Co., 26 Cortlandt street, New York, N. Y	$177.50	$122.50	$117.50	$119.00	$1,373.50
	Alternative plan	160.00				1,220.00
3	The Stewart Iron Works, Cincinnati, Ohio	850.00	861.00	832.00	832.00	2,975.00
	Alternative plan	809.00				2,888.00
4	The North Penn Iron Co., North Penn Junction, Philadelphia, Pa	189.00	98.00	78.00	80.00	1,310.00
	Alternative plan	175.00				1,219.00
5	Whitehead & Kales, Detroit, Mich	178.00	126.00	121.00	116.00	1,456.00
	Alternative plan	152.00				1,261.00
6	Robt. S. Bishop, 31 Broadway, New York, N. Y.	205.00	180.00	175.00	173.00	1,643.00
	Alternative plan	170.00				1,435.00
8	Stacey B. Opdyke, jr., 1222 Belmont avenue, Philadelphia, Pa	198.00	236.00	228.00	220.00	2,083.00
	Alternative plan	206.00				2,033.00
9	Wm. P. Greenlie, Robt. S. Wyatt, David Greenlie, 499 Water street. New York, N. Y	200.00	174.00	178.00	170.00	1,617.00
	Alternative plan	165.00				1,415.00
12	The Lawrence Bolt and Iron Works of Baltimore City, rear 422 East Pratt street, Baltimore, Md	244.09	130.05	126.05	124.55	1,632.19
	Alternative plan	200.00				1,426.65
13	Charles E. Ellicott, trading as Ellicott Machine Co., Baltimore, Md	220.00	126.00	120.00	121.00	1,570.00
	Alternative plan	187.00				1,402.00
14	Snare & Triest, incorporated, 39 Cortlandt street, New York, N. Y	250.00	220.00	210.00	210.00	2,000.00
	Alternative plan	240.00				1,980.00

a Date of delivery, within forty days after notification of approval of contract.

Abstract of proposals for iron and steel roofs, etc.—Continued.

No.	Name and address of bidder.	Class B[a]—Continued.				
		410 linear feet railings.		2 ladders.		Total.
		Per linear foot.	Total.	Each.	Total.	
2	New Jersey Foundry and Machine Co., 26 Cortlandt street, New York, N. Y	$1.10	$451.00	$9.25	$18.50	$1,843.00
	Alternative plan					1,689.50
3	The Stewart Iron Works, Cincinnati, Ohio	1.43	586.30	20.00	40.00	3,601.30
	Alternative plan					3,509.30
4	The North Penn Iron Co., North Penn Junction, Philadelphia, Pa	.47	192.70	10.00	20.00	1,522.70
	Alternative plan					1,431.70
5	Whitehead & Kales, Detroit, Mich	.72	295.20	18.00	36.00	1,789.20
	Alternative plan					1,592.20
6	Robt. S. Bishop, 31 Broadway, New York, N. Y.	1.10	451.00	12.00	24.00	2,118.00
	Alternative plan					1,910.00
8	Stacy B. Opdyke, jr., 1222 Belmont avenue, Philadelphia, Pa	1.00	410.00	20.00	40.00	2,483.00
	Alternative plan					2,483.00
9	Wm. P. Greenlie, Robt. S. Wyatt, David Greenlie, 499 Water street, New York, N. Y	1.20	492.00	10.00	20.00	2,129.00
	Alternative plan					1,927.00
12	The Lawrence Bolt and Iron Works of Baltimore City, rear 422 East Pratt street, Baltimore, Md	.77	315.70	9.25	18.50	1,966.39
	Alternative plan					1,760.85
13	Charles E. Ellicott, trading as Ellicott Machine Co., Baltimore, Md	1.12	459.20	10.00	20.00	2,049.20
	Alternative plan					1,881.20
14	Snare & Triest, incorporated, 39 Cortlandt street, New York, N. Y	1.10	451.00	13.00	26.00	2,477.00
	Alternative plan					2,407.00

No.	Name and address of bidder.	Class C.[b]					Class D.[a]
		2 lifts.		4 cranes.		Total.	For tram rails, trolleys, and hoists, complete.
		Each.	Total.	Each.	Total.		
1	A. W. Isele & Son, 51 and 53 Pitts street, Boston, Mass	$750	$1,500	$90.00	$360	$1,860	
2	New Jersey Foundry and Machine Co., 26 Cortlandt street, New York, N. Y	875	1,750	105.00	420	2,170	$1,450
5	Whitehead & Kales, Detroit, Mich						1,357
6	Robt. S. Bishop, 31 Broadway, New York, N. Y.	750	1,500	116.00	464	1,964	1,477
7	Louis Schutte, trading as L. Schutte & Co., Philadelphia, Pa	649	1,298	149.00	596	1,894	
9	Wm. P. Greenlie, Robt. S. Wyatt, David Greenlie, 499 Water street, New York, N. Y	735	1,470	98.00	392	1,862	1,525
10	The Niles Tool Works Co., Hamilton, Butler County, Ohio	1,270	2,540	260.00	1,040	3,580	2,095
11	The Brown Hoisting and Conveying Machine Co., 26 Cortlandt street, New York, N. Y						1,884
12	The Lawrence Bolt and Iron Works of Baltimore City, rear 422 East Pratt street, Baltimore, Md	975	1,950	110.25	441	2,391	
13	Charles E. Ellicott, trading as Ellicott Machine Co., Baltimore, Md	675	1,350	95.00	380	1,730	1,560

[a] Date of delivery, within forty days after notification of approval of contract.
[b] Date of delivery, within sixty days after notification of approval of contract.

The following contracts were in force during the year:

With John B. Lord, of Washington, D. C., for furnishing 3,800 cubic yards of pebbles and 3,800 cubic yards of sand. Date of contract, October 28, 1898; approved November 5, 1898; delivery to commence on or before November 3, 1898.

With the Lawrenceville Cement Company, of New York, for furnishing 11,000 barrels of American natural cement. Date of contract, October 31, 1898; approved November 22, 1898; delivery to commence on or before November 10, 1898.

With James McCuen, of Alexandria, Va., for furnishing 3,550 cubic yards of broken stone. Date of contract, June 22; approved July 12, 1899; delivery to commence within ten days after approval of contract.

With James H. McGill, of Washington, D. C., for furnishing and delivering 5,000 barrels, more or less, of Rosendale hydraulic cement of Beach's Lawrenceville brand. Date of contract, August 5; approved August 14, 1899; delivery to commence within twenty-five days after notice of approval.

RIGHT BANK POTOMAC RIVER.

Emplacements for three 8-inch guns on disappearing carriages.—This battery was built by contract dated December 16, 1896, with Douglas & Andrews, of Baltimore, Md., under the provisions of the act of Congress of June 6, 1896, providing for the construction of fortifications by contract, to be paid for as appropriations might be made from time to time therefor.

An allotment of $100,000, to be expended under the contract, was made March 27, 1897. The work was finally completed August 15, 1898.

The guns were mounted and ready for service by April 1, 1898.

No work was done during the fiscal year ending June 30, 1900.

The battery was formally turned over to the commanding officer of the post on January 13, 1900.

Emplacements for two 5-inch rapid-fire guns.—Under an allotment of $14,500, October 4, 1898, for constructing two emplacements for 5-inch rapid-fire guns, on balanced-pillar mounts, work was begun in November, 1898.

The two emplacements are entirely separated on account of the then necessity for leaving a site for a proposed two 12-inch gun battery. At the commencement of the past fiscal year the concrete work of one of the emplacements had been constructed up to a level of 2 feet below the crest, and had been built about 4 feet high at the other emplacement, the gun platform not included in either case. The excavation was mostly completed and embankment partly built. The drainage systems were both completed.

Work was continued during the summer. The concrete work of both emplacements was nearly completed except gun platforms. These can not be built until the mounts arrive. The embankments were about half finished and the doors partly constructed. The allotment was exhausted and work suspended September 6. The work is about three-fourths completed. Materials have been purchased and delivered. They were hauled to the site from the wharf in carts and wagons.

Under date of December 13, 1899, the officer in local charge reported that the sum of about $1,900 would be needed for the completion of these two emplacements.

Money statement.

July 1, 1899, balance unexpended	$4,855.50
June 30, 1900, amount expended during fiscal year	4,847.61
July 1, 1900, balance unexpended and available	7.89

Battery for three 15-pounder rapid-fire guns.—An allotment of $15,100 was made June 25, 1900, to be applied to the construction of emplacements for three 15-pounder rapid-fire guns, in accordance with plans submitted.

No work was done during the year.

Money statement.

June 30, 1900, amount of allotment (and available)	$15,100.00

Electric light and power plant.—Under the allotment of $9,032.93, October 7, 1898, for the construction of a power house and installation of a plant for light, and for operating the lifts of the 8-inch battery, the work of constructing a power house and cistern was commenced November 7, 1898. By the close of the fiscal year 1899 this part of the project was completed as far as possible until the engine and boiler should be set up.

The floors, doors, and windows, and a tile partition remain to be provided. Nothing has been done on this work during the past fiscal year excepting the submission of plans for the power and light plant.

A lot of lead-covered wire No. 12, received from Col. C. R. Suter, Corps of Engineers, is on hand for the wiring.

Prices of material, which were generally high throughout the past fiscal year, are reported as lowering, and it is hoped that a plant may be installed at an early day.

Money statement.

July 1, 1899, balance unexpended	$5,625.68
June 30, 1900, amount expended during fiscal year	221.90
July 1, 1900, balance unexpended and available	5,403.78

Battery commander's station.—Under an allotment of $4,259, July 29, 1899, for the construction of a high-site station near the 8-inch battery for mounting a type A range finder, materials were purchased and delivered and work was commenced October 5. During the autumn the excavation was made, forms built, and concrete work constructed up to about the lower surface of the concrete floor, when work closed down for the winter. It was resumed in the spring and the concrete work practically finished in June.

Materials were hauled to the site in wagons and carts. About two-thirds of the concrete was placed by wheelbarrows, but for the higher portion a small derrick was erected. The concrete was all made by hand. The work is about 60 per cent finished.

Money statement.

Allotted during the year	$4,259.00
June 30, 1900, amount expended during fiscal year	690.14
July 1, 1900, balance unexpended	3,568.86
July 1, 1900, outstanding liabilities	363.00
July 1, 1900, balance available	3,205.86

Preservation and repair of fortifications.—Under an allotment of $454, June 9, 1899, together with some funds remaining from a previous allotment, work as follows was done during the fiscal year ended June, 30, 1900:

Repairing earth slopes at the 8-inch battery; repair to drains; cleaning drains that had become clogged; altering ammunition hoists; reconstructing a small ramp wall; filling joints in granolithic superior slope of 8-inch battery with asphalt paint and darkening the color of the same superior slope; testing and cleaning searchlight outfit, and placing water barrels on the wharf and around United States engineer buildings, providing them with buckets, and keeping the barrels filled.

A further allotment of $900 for work of preservation and repair at this place was made June 11, 1900.

Money statement.

July 1, 1889, balance unexpended	$586.62
Allotted during the year	900.00
	1,486.62
June 30, 1900, amount expended during fiscal year	431.30
July 1, 1900, balance unexpended	1,055.32
July 1, 1900, outstanding liabilities	66.00
July 1, 1900, balance available	989.32

All the work at this locality was done by hired labor.

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3 J.

DEFENSES OF HAMPTON ROADS, VIRGINIA.

Officers in charge, Maj. Thomas L. Casey, Corps of Engineers, until December 21, 1899, and Maj. James B. Quinn, Corps of Engineers, since that date; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Fort Monroe, Va.—This fort is of the old type and is garrisoned. In conjunction with Fort Wool, on the opposite side of the channel, it is to defend the only approach from the sea to the cities of Norfolk, Portsmouth, and Berkley, Va., and the cities and towns along the James River and its tributaries.

On June 30, 1900, the modern armament at this point consisted of seven 10-inch rifles, sixteen 12-inch mortars, three 8-inch guns, one of which forms a part of the projected defense, the others being temporary, and four 4.72-inch rapid-fire guns. Besides this armament, emplacements are practically complete for one additional 10-inch gun, which is on hand but has not been mounted, three 12-inch guns, and four 15-pounder rapid-fire guns. In connection with the service of the above guns, the fire commander's and four observation stations have been built.

For defending the locality by submarine mines, two casemates have been constructed and a storage tank for cable provided.

In the fiscal year 1901 work will be confined to finishing up the works now nearly completed and in building one of the battery commanders' stations, constructing a concrete sea wall to the first jetty on the beach, and making such repairs to the old and modern works as may be necessary.

The operations during the fiscal year ended June 30, 1900, were as follows:

Emplacement for 10-inch gun on spit.—This work had been finished with the exception of wiring the emplacement for the electric lights and a few other minor details at the close of the fiscal year 1899.

In the present fiscal year work has been done toward finishing the electric-lighting installment and in making and erecting an iron ladder leading from the platform to the parapet. The system for conveying ammunition has been painted, as also have the plates fastened to the surface of the concrete between the extreme angles of fire to protect it from erosion by the blast of the gun. New locks and keys were provided for the magazine and other doors, and drift sand removed from and in rear of the shell recess, and from the platform. The slopes have been kept in repair and the grass cut therefrom.

Work on the electric storage battery plant and the wiring was stopped July 31, 1899, when quarantine restrictions were enforced, due to the prevalence of yellow fever at Hampton Soldiers' Home, the contractors ordering their forces home. The storage battery had been set up when work stopped, but very little had been done on the interior wiring and this was not resumed till March of the present year. With the exception of drawing the wires into the conduit and testing the system, the electric-lighting installation is complete. Some expense for keeping the storage battery in good order was caused on account of the delay in completing the interior wiring.

The garrison finished mounting the gun and carriage for this emplacement on January 31, 1900, and during March last tested the carriage, which is an experimental one patterned somewhat after the 1894 model. With exception of some slight settlement of the exterior slope, due to the jar occasioned by the discharge of the gun, there were no imperfections noted.

Money statement.

July 1, 1899, balance unexpended	$2,372.17
June 30, 1900, amount expended during fiscal year	1,779.64
July 1, 1900, balance unexpended	592.53
July 1, 1900, outstanding liabilities	592.53

Emplacement for 10-inch gun in bastion.—At the close of the fiscal year 1899 all the concrete for this work had been placed, except that required in building part of the platform and for laying floors in the magazines and passageways. The other work to be done was the completion of the sand cover, installing the ammunition lift and trolley system for conveying purposes, providing electric storage battery and wiring for lighting, and some other details of minor importance.

During the present fiscal year 437 cubic yards of concrete were mixed and rammed into position at the platform and placed in laying the floors of the magazines and passageways, and the surfaces of the former and latter covered with 439 square yards of granolithic. The surface of the concrete on the parapet was covered with Portland-cement mortar.

For the slopes 4,112 cubic yards of the 5,685 cubic yards of sand, removed in excavating at the site to reach the proper reference to lay the foundation for the work, were rehandled, and of 1,875 square yards of sod, 348 cubic yards each of clay and soil, removed when excavation was being made for foundation, 1,607 square yards of the former and 343 cubic yards each of the latter were used in forming the new slopes.

Work on the lighting arrangement was delayed for the reason stated in the case of the emplacement on spit, but it is expected that the system will be ready for testing early in the fiscal year 1901, as all that remains to be done is to draw the wires in the conduit and then connect up the interior wiring with the electric storage battery.

The lift and trolley system for the serving of ammunition to the gun was installed during the year. For operating the lift a small 110-volt motor has been provided.

Besides the above, an iron ladder was made and placed as a means of reaching the parapet direct from the gun platform, and a relocator house of brick and concrete, 12 feet by 16 feet, was built in the rear of the emplacement.

The construction work during the fiscal year was carried on with the same plant and by the same methods as given in the last Annual Report. (See pp. 835 and 836 Annual Report for 1899.)

To date, the following necessary construction work has been done on this emplacement:

Sand excavated for foundation	cubic yards	5,685
Clay removed from site	do	348
Soil removed from site	do	348
Sod removed from site	square yards	1,875
1-inch broken stone unloaded and hauled to work	cubic yards	1,107.9
2-inch broken stone unloaded and hauled to work	do	1,823.4
Granolithic broken stone unloaded and hauled to work	do	26.1
Rosendale cement unloaded and hauled to work	barrels	5,134
Portland cement unloaded and hauled to work	do	250
Concrete mixed and rammed	cubic yards	3,495
Granolithic finish put on concrete surfaces	square yards	439
Sand rehandled and put in slopes	cubic yards	4,112
Clay rehandled and put on slopes	do	343
Soil rehandled and put on slopes	do	343
Sod rehandled and put on slopes	square yards	1,607

The principal materials needed were purchased under contract, the prices paid being as follows, delivered alongside the engineer wharf, the unloading being done by the United States:

American cement, "Brooklyn Bridge" brand, per barrel	$0.66⅔
Portland cement, "Atlas" brand, per barrel	2.30
Broken stone, 1-inch size, per cubic yard	1.38 3/16
Broken stone, 2-inch size, per cubic yard	1.38 3/16
Granolithic stone, per cubic yard	1.38 3/16

The average cost per cubic yard of concrete in place for this emplacement was $5.14. The plant used in construction was on hand, and the only expenses on this account were for moving the mixer and engine to the site, connecting them up, moving and erecting water tank, and placing the platforms for mixing the concrete, for which $124.15 were expended, making the average cost per cubic yard of concrete placed 3½ cents. The repairs to plant averaged 10.2 cents per cubic yard of concrete placed.

As soon as the small amount of work on the electric-lighting arrangement is completed this emplacement will be ready to be turned over to the garrison.

The gun and carriage for the emplacement have been received and part of the carriage had been assembled on the platform at the close of the fiscal year.

Money statement.

July 1, 1899, balance unexpended	$19,506.80
June 30, 1900, amount expended during the fiscal year	12,464.18
July 1, 1900, balance unexpended	7,042.62
July 1, 1900, outstanding liabilities	917.50
July 1, 1900, balance available	6,125.12

Three 10-inch gun emplacements.—These emplacements are complete, with the exception of finishing the electric-lighting arrangements. Full information as to the same may be found on page 836 and pages 843 and 844 of the Annual Report of the Chief of Engineers for 1899.

The work in the fiscal year 1900 was confined to finishing the slope at the north end of Redoubt C, which could not be completed, as the 5-foot cubical concrete-mixer plant was in the way, and to setting up the electric storage battery and putting up conduit for the wiring for the lamps.

In completing the slope at the north end of Redoubt C 1,323 cubic yards of sand, 63 cubic yards of clay, 78 cubic yards of soil, and 562 square yards of sod were placed.

The work on the electric-light arrangement has been delayed, as stated in the preceding reports, but at the close of the year all conduits were in place and the only work remaining to be done was drawing wires in the conduit and connecting up and testing the electric storage battery and the wiring.

Money statement.

July 1, 1899, balance unexpended	$2,780.46
June 30, 1900, amount expended during fiscal year	934.70
July 1, 1900, balance unexpended	1,845.76
July 1, 1900, outstanding liabilities	1,831.20
July 1, 1900, balance available	14.56

Emplacements for three 12-inch guns.—Work on these emplacements was begun in July, 1898. The methods adopted, the plant used in construction, and the work done to July 1, 1899, are fully described on page 837 of the Annual Report of the Chief of Engineers for 1899.

During the fiscal year 1900 operations were carried on in the same manner as heretofore, and a total of 7,687 cubic yards of concrete was mixed and placed, 3,700 cubic yards of which were delivered from the mixer plant at the mortar battery, and 3,987 cubic yards from the 5-foot cubical mixer at Redoubt C. The exposed surfaces of all walls were given a coating of cement plaster and the top surface of the platforms, the floors of the shell recesses and passageways, and all steps were covered with granolithic, the aggregate of the surfaces so covered being 3,075 square yards.

In the embankment 18,108 cubic yards of sand, 724 cubic yards of clay, 721 cubic yards of soil, and 3,163 square yards of sod have been placed. The sand was procured from the dunes in the vicinity of Redoubt B and delivered in cars over the railroad, and the clay, soil, and sod were taken from the United States land on the north bank of Mill Creek and transported across the creek in lighters, and thence taken by rail to the point desired for unloading it at the work.

Besides the above the ammunition lifts and trolley tracks have been installed, the conduit for electric wires put up, the electric storage battery—with the exception of three of the cells, which were broken in transit—has been set in place, the doors for the magazines made and hung, 27 stones cut for setting hinges for doors, and other minor work performed, as follows: Making and placing iron ladders leading from the platforms to the parapets, wooden steps from parades to loading platforms, providing the stanchions for railing around loading platforms, and the work required in keeping the plant used in good working order.

The following materials were delivered under contracts at the prices stated, the United States unloading it from vessels at the engineer wharf:

5,900 barrels of Rosendale cement, "Brooklyn Bridge" brand, at 66⅔ cents.
1,050 barrels Portland cement, "Atlas" brand, at $2.30.
1,835 cubic yards 1-inch broken stone, at $\$1.38\frac{9}{10}$.
4,368 cubic yards 2-inch broken stone, at $\$1.38\frac{9}{10}$.
113 cubic yards granolithic stone, at $\$1.38\frac{9}{10}$.

All other material and supplies were purchased under public notices of ten days, whenever the work in hand did not demand immediate delivery.

On June 30, 1900, the emplacements were complete, except in the following respects: Connecting up and testing electric storage battery and wiring and completing slope at southern end of the battery, which is occupied by parts of the carriage, thus preventing any work being done until the garrison assembles the carriages at the platforms.

Money statement.

July 1, 1899, balance unexpended	$92, 732. 69
June 30, 1900, amount expended during fiscal year	58, 767. 16
July 1, 1900, balance unexpended	33, 965. 53
July 1, 1900, outstanding liabilities	3, 632. 95
July 1, 1900, balance available	30, 332. 58

The following relates to all the foregoing works:

Abstract of contracts in force.

Name of contractor.	Date of approval.	Date of beginning work.	Date of expiration.
New York and Rosendale Cement Co	Oct. 27, 1898	Dec. 1, 1898	Jan. 19, 1900
R. H. Hood Co	Nov. 28, 1898	Jan. 1, 1899	Jan. 22, 1900
Kingsbury, Samuel & Co	May 1, 1899	May 12, 1899	Aug. 12, 1899
Brown Electrical Construction Co	do	do	Do.

Emplacement for four 15-pounder rapid-fire guns.—The construction of this battery has been contemplated for some time, but the plans were not approved until January 13, 1900, an allotment of $12,500 being made at the same time from the act of July 7, 1898, for the work.

The surface of the site was 6 feet above mean low water, and, as the foundation was to be commenced at a height of 8 feet above that plane, a fill of 2 feet was necessary, which was made with 1,349 cubic yards of sand. The sand was settled with water and well rammed. Around the outer edges of the fill lumps of old concrete, specially broken up for the purpose, were placed to prevent washing by high tides. One of the observation stations occupied a part of the site for this battery, and this was demolished, the sod, soil, clay, and sand around the same being removed to a convenient place for use in connection with the construction of the battery.

Proposals for furnishing and delivering the principal materials required, in addition to the supply left over from the 12-inch battery, in constructing the battery, were solicited by newspaper advertising under date of February 15, 1900, and the bids received were opened at noon on March 17, 1900, and abstracts of them will be found further on in this report. The prices at which the different materials were furnished and the amount of each kind delivered are as follows:

750 barrels Rosendale cement, "Hoffman" brand, at $1.05.
125 barrels Portland cement, "Alpha" brand, at $2.40.
591 cubic yards 1-inch broken stone, at $1.54.
583 cubic yards 2-inch broken stone, at $1.54.
31 cubic yards granolithic stone, at $1.54.

The above prices were for the material in vessels alongside the engineer wharf, the unloading to be done by the United States.

While waiting for the material to be delivered the plant for the construction work was arranged and the battery laid out. The plant provided consisted of the continuous concrete mixer, pump, and water tank used in the building of the 10-inch emplacement in the bastion of the main work, all of which were moved from inside the fort to a position near the work. In addition bins for the three sizes of broken stone and one for sand were built on the inner side of the railroad track, so that the material could be dumped directly from the cars into them.

The battery, at the close of the fiscal year, is practically completed, the remaining work to be done being the finishing up of the slope at the west end, making and placing doors for magazines, putting granolithic on part of the steps and platforms, and doing a little grading in rear of the battery.

The volume of the concrete placed during the fiscal year amounted to 1,086 cubic yards. The sand hauled over the railroad from the dunes near Redoubt B and unloaded in building the embankment amounted to 1,463 cubic yards, and the clay, soil, and sod placed on the slopes aggregated 124 and 124 cubic yards and 759 square yards, respectively. The granolithic put down on steps and platforms aggregated 149 square yards.

Money statement.

January 13, 1900, amount allotted	$12,500.00
June 30, 1900, amount expended during fiscal year	6,800.72
July 1, 1900, balance unexpended	5,699.28
July 1, 1900, outstanding liabilities	1,470.88
July 1, 1900, balance available	4,228.40

Abstract of bids for furnishing and delivering cement, broken stone, and yellow pine lumber received in response to advertisement dated February 15, 1900, and under specifications of the same date, opened by Maj. James B. Quinn, Corps of Engineers, United States Army, at Norfolk, Va., at 12 m. on March 17, 1900.

CLASS A.—AMERICAN CEMENT.

No.	Name and address of bidder.	Brand.	Price bid per barrel.	Approximate quantity.	Total.
				Barrels.	
1	The National Building Supply Co., Baltimore, Md. *a*	Ulster County	$1.25	750	$937.50
2	B. Wallis & Co., Baltimore. Md. *b*	Cumberland or Hoffman.	1.25	750	937.50
4	Wm. Wirt Clarke & Son, Baltimore, Md. *c*	Union, Akron, Star	1.35	750	1,012.50
5	Lawrenceville Cement Co., New York, N. Y. *d*	Beach's	1.10	750	825.00
6	Mayo & Rohrer Co., New York, N. Y.	Rosendale	1.15	750	862.50
8	Warner Moore & Co., Richmond, Va. *e*	do	1.05	750	787.50
10	S. H. Hawes & Co., Richmond, Va. *f*	Newark	1.14	750	855.00
12	Gamage & Waller, Norfolk, Va. *h*	Brooklyn Bridge	1.10	750	825.00
13	General Supply Co., Norfolk, Va. *i*	Ulster	1.34¾	750	1,010.63

CLASS B.—PORTLAND CEMENT.

No.	Name and address of bidder.	Brand.	Price bid per barrel.	Approximate quantity.	Total.
2	B. Wallis & Co., Baltimore, Md. *b*	Vulcanite or Star	$2.55	125	$318.75
4	Wm. Wirt Clarke & Son, Baltimore, Md. *c*	Teutonia German	2.60	125	325.00
6	Mayo & Rohrer Co., New York, N. Y.	Atlas	2.60	125	325.00
8	Warner Moore & Co., Richmond, Va. *e*	Alpha or Lehigh	2.40	125	300.00
9	Jac. Heffelfinger, Hampton, Va	Nazareth	2.45	125	306.25
10	S. H. Hawes & Co., Richmond, Va. *f*	Star	2.51	125	313.75
12	Gamage & Waller, Norfolk, Va. *h*	Lehigh or Nazareth	2.45	125	306.25
13	General Supply Co., Norfolk, Va. *i*	Atlas	2.49¾	125	312.19

CLASS C.—BROKEN STONE.

No.	Name and address of bidder.	2-inch.			1-inch.		
		Price bid per cubic yard.	Approximate quantity	Total.	Price bid per cubic yard.	Approximate quantity.	Total.
			Cubic yards.			*Cubic yards.*	
3	McClenahan & Bro. Granite Co., Port Deposit, Md	$1.99	600	$1,194	$2.21	500	$1,105
5	Lawrenceville Cement Co., New York, N. Y. *d*	1.56	600	936	1.56	500	780
6	Mayo & Rohrer Co., New York, N. Y	1.54	600	924	1.54	500	770
7	Charles G. Smith & Son, Washington, D. C.	1.97	600	1,182	2.17	500	1,085
11	Benj. F. Pope, Baltimore, Md. *g*	2.15	600	1,290	2.15	500	1,075

No.	Name and address of bidder.	Granolithic.		
		Price bid per cubic yard.	Approximate quantity.	Total.
			Cubic yards.	
3	McClenahan & Bro. Granite Co., Port Deposit, Md	$2.55	25	$63.75
6	Mayo & Rohrer Co., New York, N. Y.	1.54	25	38.50
7	Charles G. Smith & Son, Washington, D. C	2.48	25	62.00
11	Benj. F. Pope, Baltimore, Md. *g*	3.50	25	87.50

CLASS D.—YELLOW PINE LUMBER.

No.	Name and address of bidder.	Approximate quantity, feet, B. M.	Aggregate amount of bid.
9	Jac. Heffelfinger, Hampton, Va	8,820	$136.60

a Date of bid in guaranty not given; no certificate as to premium paid; internal-revenue stamps not cancelled.
b Date of proposal in guaranty omitted; signature to proposal informal.
c Fifty-cent internal-revenue stamp not affixed.
d No 50-cent internal-revenue stamp or evidence of authority of officer of company to sign proposal.
e No certificate as to guarantors; signature to proposal informal.
f No certificate as to premium paid surety Company; signature to proposal informal.
g No certificate as to amount of premium paid surety Company.
h No 50-cent internal-revenue stamp affixed; signature to proposal informal.
i Date of proposal in bid and guaranty do not correspond.

Balance available March 20, 1900, from appropriation for "Gun and Mortar Batteries," act of July 7, 1898, allotment of January 13, 1900, for emplacements for four 15-pounder rapid-firing guns, for payment of above material, $11,850.52.

Abstract of contracts in force.

Name of contractor.	Date of approval.	Date of beginning delivery.	Date of expiration.
Warner Moore & Co	Apr. 9, 1900	Apr. 12, 1900	May 12, 1900
Mayo & Rohrer Co	Apr. 18, 1900	Apr. 1, 1900	Apr. 30, 1900

Mortar battery.—Three separate allotments were made during the year 1900 for work on this battery.

On August 31, 1899, the sum of $500 was provided from the appropriation for "Preservation and Repair of Fortifications," act March 3, 1899, for putting down a sloping roof of concrete heavily asphalted from the rims of the revetment walls to the crest of the superior slope in front of each mortar pit.

The object of this work was to carry off the water from the slope, which, since the drains placed in the reentering angles above the pits where the revetment walls join the main work became clogged, percolated through the earth cover and concrete into the shell rooms of the battery.

The work was performed by excavating about 375 cubic yards at the points where the sloping concrete roof was to be put down, and the concrete, heavily coated with asphalt, was then laid. The result has been very satisfactory. Materials for the work were on hand, which accounts for its small cost.

By allotment of December 29, 1899, from several acts appropriating funds for gun and mortar batteries, $1,000 were provided for the erection of a ventilating system designed to overcome the trouble experienced from condensation of moisture upon the walls of magazines, shell rooms, and passageways of the battery.

Public notice was issued March 15, 1900, for the material and labor required, with the exception of the engine and shelter for same, the former being on hand and the latter to be built by the United States. The bids received were opened April 2, 1900, an abstract of which is appended. The lowest bid being considered excessive, all were rejected and offers for the material alone solicited, with the result that an agreement was made with the B. F. Sturtevant Company to supply the material for $440, which was the lowest one received.

The system consists of a line of No. 22 galvanized 9-inch pipe run through the passageways and shell rooms, with four branches at right angles thereto to the magazines, suspended by hangers fastened to the steel I-beams in the ceilings, the center of the pipe being 14 inches from the ceiling. At the ends of the line, at the end of each branch, and on the main line on the farther side of each branch from the vertical line to the exhauster blast gates of the slide pattern were provided. The main line is about 451 feet in length and the branches aggregate 72 feet.

The engine for operating the exhauster is the 7-horsepower oil engine purchased for the mortar battery electric-light plant and which is not needed for that service on account of the connecting up of the storage battery and the electric-light wires at this work with the electric plant at Redoubt B. The exhauster is a No. 6 left-hand upblast discharge machine manufactured by the B. F. Sturtevant Company, of Boston, Mass. Both the engine and exhauster were installed in a sunken covered pit constructed on the superior slope of the battery at about the center, and the pipe to the exhauster from the main line is run up the 16-inch chimney previously used by the electric plant. The pipe for this latter line is of No. 20 galvanized pipe, 14 inches in diameter, and the same size of pipe was used from the outlet on the exhauster through the roof of the shelter.

The cost of the work was $1,000.

It was recommended that concrete steps be placed up the slope of the center traverse of the battery as a means of reaching its crest from the pits, in lieu of the then existing means, which consisted of a single plank on which cleats had been nailed, and on April 30, 1900, $246 were allotted from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899.

The work has been completed. The flight of steps extend over a distance of about 70 feet, from the crest of the sand cover to the toe of the slope at the center traverse. They are of concrete, with 12-inch tread and 7-inch rise. At intervals of 20 feet, platforms 2 feet 10 inches, 3 feet 10 inches, and 4 feet long, having a width of 4 feet, were provided. At the crest a 10½ by 4 foot platform was laid.

Besides the excavation required for the steps 25 cubic yards of concrete were mixed and placed and the exposed surfaces of the steps and platforms were covered with granolithic, which required about 25 square yards.

The full amount of the allotment was required in constructing the steps and platforms.

Money statement.

GUN AND MORTAR BATTERIES.

June 30, 1900, aggregate of allotments during fiscal year	$1,246.00
June 30, 1900, expended during fiscal year	904.45
July 1, 1900, balance unexpended	341.55
July 1, 1900, outstanding liabilities	341.55

PRESERVATION AND REPAIR OF FORTIFICATIONS.

August 31, 1899, amount allotted	$500.00
June 30, 1900, expended during fiscal year	500.00

Abstract of proposals for furnishing and placing an exhauster and the necessary pipe and fittings for a ventilating system received in response to public notice dated March 15, 1900, and under specifications of the same date, opened by Maj. James B. Quinn, Corps of Engineers, United States Army, at Norfolk, Va., on April 2, 1900, at 12 o'clock noon.

No.	Name and address of bidder.	Price bid.
1	New Jersey Foundry and Machine Co., New York, N. Y	$929.00
2	Ellicott Machine Co., Baltimore, Md	1,050.00
3	Robt. S. Bishop, New York, N. Y	990.00

All bids rejected as being too high.

Surveys for Board on range finders.—The sum of $100 was provided from the appropriation for "Gun and Mortar Batteries," in the act of

July 7, 1898, on July 20, 1899, to enable data to be furnished the Board on Location of Position Finders as to the elevations, etc., of sites selected for the construction of range towers.

The necessary triangulation was made and elevations of sights secured and the information forwarded to the Board.

Money statement.

July 20, 1899, amount allotted	$100.00
June 30, 1900, expended during fiscal year	98.16
March 17, 1900, repaid to appropriation	1.84

Concrete walk, Redoubt A.—On June 22, 1900, $626 were allotted from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, to be applied to the construction of a walk of concrete, finished with granolithic, in the rear of Redoubt A, and also putting down a concrete covering on the ramps leading to each of the platforms of this battery.

No work has been done. The walk when completed will be 376 feet long and 4 feet wide, and the area of each ramp to be covered is 44 by 6 feet.

Money statement.

June 22, 1900, amount allotted	$626.00
July 30, 1900, balance unexpended	626.00

Range tower.—In accordance with the instructions from the Chief of Engineers, detailed plans for the battery commander's station near the mortar battery are in course of preparation and will be submitted early in the fiscal year 1901. It is proposed to undertake the construction of this station with funds appropriated by the act of May 25, 1900, for the installation of range and position finders.

Sea wall.—Plans are in course of preparation for constructing about 900 feet of the sea wall proposed to be built from the eastern side of the Engineer wharf to the further side of the first jetty on the beach, and will be submitted as ordered by the Department on June 4, 1900. The sum of $12,000 is to be provided for the work from the appropriation for "Sea Walls and Embankments" in the act of May 25, 1900.

Supplies for coast defenses.—To enable the procurement of articles to be supplied to the artillery by the Engineer Department as required by General Orders, No. 66, Adjutant-General's Office, 1900, the sum of $1,000 was allotted from the appropriation for the purpose indicated above in the act of May 25, 1900, to be applied to filling such requisitions as are duly approved by the Chief of Engineers during the fiscal year 1901.

Money statement.

June 7, 1900, amount allotted	$1,000.00
July 1, 1900, balance unexpended	1,000.00

Preservation and repair of fortifications.—During the fiscal year 1900 general preservation and repair work was performed under an allotment from the appropriation therefor in the act of May 7, 1898, made on June 9, 1899, and amounting to $2,135.

The following work was done: The bridge at the north entrance was repaired, the deck plank being renewed, some of the stringers taken out and replaced by new timber, and the railing repaired and painted; the drains at the foot of the ramps were repaired and cleaned, and the engineer buildings, quarters, and fences surrounding them were repaired; slight work was done on repairing the engineer wharf; the railroad trestle to Redoubt A was strengthened, and the trolley system at the place of arms was put in proper working order.

August 1, 1899, $200 was allotted for repairing the torpedo material and for examining and cleaning the electrical instruments pertaining to the said material. A special report as to this work and the condition in which the electrical instruments were found upon examination was made on September 22, 1899.

The exterior of the fire commander's station was found to be badly in need of painting, and $50 was provided by special allotment on January 23, 1900, and the outer tower and the instrument shelter were given a coat of paint in February last.

The allotment of $500 for work on the mortar battery is referred to in the report for that work.

Under an allotment of $150 made April 6, 1900, a harbor chart for this point was drawn in accordance with the instructions issued in relation thereto, and the tracing submitted June 13, 1900.

On June 18, 1900, $1,000 was allotted for preserving and repairing the submarine material at this place during the fiscal year 1901, and on June 27, 1900, $36 was allotted to be applied to providing and placing shelters for six hygrometers for the works which have been turned over to the troops.

Money statement.

July 1, 1899, balance unexpended		$2,135.59
June 30, 1900, aggregate of allotments during fiscal year		1,936.59
		4,072.18
July 1, 1899, amount withdrawn	$0.59	
June 30, 1900, amount expended during fiscal year	2,992.82	
		2,993.41
July 1, 1900, balance unexpended		1,078.77
July 1, 1900, outstanding liabilities		46.15
July 1, 1900, balance available		1,032.62

Fort Wool, Va.—This work unites with Fort Monroe in closing the sea approach to Hampton Roads, being located on the opposite side of the channel from that work and crossing its fire with it.

Fort Wool is an inclosed casemated fort. It was begun in 1818 by forming an artificial foundation of stones of random sizes unloaded upon a 10-foot shoal, selected as the site of the work. When the scarp walls and piers had reached a height to include the lintels of the lower tier of embrasures, settlement began, and work was stopped after piling a quantity of stone upon the walls sufficient to bring upon the foundation a pressure somewhat exceeding that of the finished work.

The work of construction was resumed in 1858, and when it was suspended fifty-two casemates of the lower tier, with iron-throated embrasures, were finished and ready for guns. On the second tier, the scarp walls and piers of those portions of the work bearing on the channel had reached nearly to the height of the embrasure lintels, the embrasure irons had been set, and the floors of most of the casemates paved. On the gorge faces very little work had been done.

There is a quantity of public property, such as building material, etc., stored in the fort. A fort keeper is in charge of the public property.

The fort has remained in the charge of a custodian during the year.

Money statement.

July 1, 1899, balance unexpended	$625.24
June 30, 1900, amount expended during the fiscal year	552.50
July 1, 1900, balance unexpended	72.74
July 1, 1900, outstanding liabilities	72.74

3 K.

DEFENSES OF THE COAST OF NORTH CAROLINA.

Officer in charge, Capt. E. W. Van C. Lucas, Corps of Engineers; assistant, Lieut. Earl I. Brown, Corps of Engineers, until September 6, 1899; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Defense of entrance to Beaufort Harbor.—No work was done during the year.

Reservation at Southport.—No work was done during the year. New fences and minor repairs to building are needed. The building has been used for office and storage purposes, as heretofore.

The suits for possession of the reservation or parts thereof, referred to in last Annual Report, are still pending.

Defense of mouth of Cape Fear River.—At the beginning of the fiscal year work was in progress on the emplacements for eight 12-inch mortars, and the torpedo storehouse was nearly completed. The mortar emplacements have been completed and carriages and guns mounted, and the battery needs only the installation of the electric firing apparatus before turning over to the garrison. The two emplacements for 5-inch rapid-fire guns are in the same condition as last year, awaiting armament.

An ammunition lift for 4.7-inch rapid-fire gun was purchased and installed and is reported by the post commander as able to supply ammunition faster than it can be used. This lift is a double platform, working on an endless chain and operated by a crank. It is similar to the lift installed for the same style gun near Baltimore, excepting that each platform is arranged for two complete charges instead of one, and the height of lift is 20.15 feet.

With allotments from the appropriation for "Preservation and Repair of Fortifications," considerable work of improvement and repair has been done on the different batteries, including releveling 8-inch guns and improving drainage system of the 8-inch battery. The original drainage system consisted of vertical pipes from floor levels to the sand beneath, and has proved unsatisfactory and unreliable to such an extent as to be a source of frequent complaint. Authority was obtained from the Chief of Engineers for the installation of a positive drainage system, with outlet outside of the battery, and at the same time the sills of the outer doors at the magazine level were raised, and corrugated iron roofs placed over platforms outside of ammunition lifts at upper level to stop the entrance of rain water during driving storms. Finally, to prevent the stoppage of drainpipes by sand from the slopes joining the terreplein and the lower level outside of magazines, which slopes were originally turfed, the turfing was replaced by concrete revetments, resulting in improved appearance and stoppage of the sand movement. As a result of this work the drainage system for this battery is now in satisfactory condition, although leakage through cracks has not yet been stopped; and it will probably be necessary to cover all the exposed top surfaces of the concrete with a thin layer of asphalt pavement similar to that successfully used in the defenses of the Delaware River.

Concerning leakage.—At the mortar battery (the last built at this locality) the concrete was placed in horizontal layers about 8 inches thick, each course being slightly higher in the center than at the outer walls, in order that if horizontal cracks should develop, the tendency would be for them to follow natural cleavage lines and drain to the outside. Such natural horizontal cleavage planes are believed, in addition, to have a tendency to break the continuity of vertical cracks. The top surfaces of this battery were covered with sand and were also covered with a thin coating of asphalt applied with a brush. To the present time, about one year after completion of concrete, no leakage in this battery has been noticed.

The experience at this place indicates that leakage can best be prevented by external treatment, it being found easier to prevent the water entering the concrete mass at the outside than to take care of it after it enters, and such outside treatment should extend not only to the concrete mass in the traverses and over magazines, but also to the platform itself, either on the top surface or immediately below. Attention is invited to the device for stopping cracks by cutting scores in concrete and covering with sheet lead, etc. This originated with Superintendent Schuster, in local charge of construction work, and is explained in his detailed report submitted herewith. It has been recently tried and has so far proved very successful for local application to well-defined cracks.

The condensation problem has not been satisfactorily solved, although the indications are that in the emplacements at this point it may to a great extent be checked by the construction of false ceilings and walls with insulating air space separating them from the concrete mass. No arrangements whatever were made for blowers, and their effectiveness has not been determined here. In the mortar battery the ceiling beams in the eastern and middle traverses were so set as to expose their lower flanges, and there is always more condensation on the metal than on the intervening concrete surfaces. In the western traverse the beams are completely buried, and the condensation is considerably less.

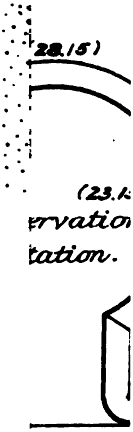
Damage by storm.—The heavy gale of October 30–31, 1899, did serious damage at the fort, as explained in report of November 27, 1899, printed as House Ex. Doc. No. 204, Fifty-sixth Congress, first session, copy of which, and indorsements thereon, is hereto appended.

By act approved May 25, 1900, $150,000 was appropriated for a sea wall and fill, and at the end of the fiscal year a project for the expenditure of this money had been submitted and will be carried into effect as rapidly as possible after its approval by the Secretary of War.

Two sheets of drawings, showing ammunition hoist for 4.7-inch rapid-fire gun and details of construction, are submitted herewith.

All work done at this locality during the year has been in local charge of Supt. Charles Schuster, whose detailed report is submitted herewith.

THE NORRIS PETERS



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Money statements.

NATIONAL DEFENSE.

Twelve-inch emplacements.

July 1, 1899, balance unexpended	$66.30
June 30, 1900, amount expended during fiscal year	21.40
July 1, 1900, balance unexpended	44.90
July 1, 1900, outstanding liabilities	44.90

One 8-inch emplacement.

July 1, 1899, balance unexpended	$22.50
July 1, 1900, balance unexpended	22.50
July 1, 1900, outstanding liabilities	22.50

Installing ammunition lift in 4.7-inch rapid-fire emplacement.

June 30, 1900, amount allotted during fiscal year	$600.00
June 30, 1900, amount expended during fiscal year	473.36
July 1, 1900, balance unexpended	126.64
July 1, 1900, outstanding liabilities	32.33
July 1, 1900, balance available	94.31

Mounting eight 12-inch mortars and carriages.

July 1, 1899, balance unexpended	$1,896.10
June 30, 1900, amount expended during fiscal year	1,789.72
July 1, 1900, balance unexpended	106.38
July 1, 1900, outstanding liabilities	12.00
July 1, 1900, balance available	94.38

Mounting two 12-inch guns.

July 1, 1899, balance unexpended	$186.47
June 30, 1900, amount expended during fiscal year	186.47

Emplacements for two 5-inch rapid-fire guns.

July 1, 1899, balance unexpended	$953.21
June 30, 1900, amount expended during fiscal year	383.92
July 1, 1900, balance unexpended	569.29
July 1, 1900, outstanding liabilities	3.60
July 1, 1900, balance available	565.69

Installing storage battery in 8-inch gun battery.

July 1, 1899, balance unexpended	$191.95
June 30, 1900, amount expended during fiscal year	191.95

Mortar battery.

July 1, 1899, balance unexpended	$16,258.27
June 30, 1900, amount expended during fiscal year	15,855.68
July 1, 1900, balance unexpended	402.59
July 1, 1900, outstanding liabilities	91.60
July 1, 1900, balance available	310.99

Contract work—8-inch emplacements.

July 1, 1899, balance unexpended	$262.22
June 30, 1900, amount expended during fiscal year	251.81
July 1, 1900, balance unexpended	10.41
July 1, 1900, outstanding liabilities	10.41

TORPEDOES FOR HARBOR DEFENSE.

Alterations in mining casemate.

July 1, 1899, balance unexpended	$1.50
June 30, 1900, amount expended during fiscal year	1.50

Torpedo storehouse.

July 1, 1899, balance unexpended	$1,388.26
June 30, 1900, amount expended during fiscal year	1,388.26

Cable tank.

July 1, 1899, balance unexpended	$153.98
June 30, 1900, amount expended during fiscal year	153.98

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended, $961.56; allotted since, $2,225	$3,186.56
June 30, 1900, amount expended during fiscal year	1,386.21
July 1, 1900, balance unexpended	1,800.35
July 1, 1900, outstanding liabilities	246.12
July 1, 1900, balance available	1,554.23

SEA WALL, FORT CASWELL, N. C.

June 30, 1900, amount appropriated by act May 25, 1900	$150,000.00
June 30, 1900, amount expended during fiscal year	26.32
July 1, 1900, balance unexpended	149,973.68
July 1, 1900, outstanding liabilities	92.17
July 1, 1900, balance available	149,881.51

SUPPLIES FOR SEACOAST DEFENSES.

June 30, 1900, amount allotted during fiscal year	$700.00
July 1, 1900, balance unexpended and available	700.00

REPORT OF CAPT. E. W. VAN C. LUCAS, CORPS OF ENGINEERS, UPON STORM AT FORT CASWELL, N. C.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., November 27, 1899.

GENERAL: In compliance with telegram from your office, dated the 2d instant, I have the honor to submit the following detailed report of damage by the storm of October 30 and 31 at Fort Caswell, N. C., and the work of repair and protection rendered necessary in consequence.

During October 30 the wind blew hard from the northeast, continuing until early the next morning, when it shifted suddenly to the southeast and blew with great violence from that direction for several hours later.

The damage was apparently done by the water forced over the beach by this southeast wind.

On the accompanying blue print No. 1* is approximately shown, by yellow shading, the area above ordinary high-water line overflowed during the storm, the overflowed area extending west of Battery Shipp for about half a mile beyond the area shown on the blue print. The map shows probably less than the actual area submerged, the shading being limited by the 10-foot contour, whereas marks on buildings indicate an extreme high-water level of 10.7 feet, making a rise of over 6 feet above ordinary high-water level. The wave action extended in places as high as the 12-foot level, the adopted building level for fortification work on the post.

This map illustrates how seriously the available area of the post was reduced.

In detail, the damage due directly to this storm is as follows:

Communications were rendered completely unserviceable, the railroad being cut through in five places and obliterated west of Battery Bagley; the wagon road destroyed in two places and obliterated west of Battery Bagley; the old wharf seriously damaged, and the new wharf cut off from land.

This destruction of communications constitutes a most serious feature of the damage, as the batteries generally were cut off from each other and from the wharves, and several days were required, even with the considerable organized engineering party, which ordinarily would not be present, to restore to working condition the railroad alone between the new wharf and Battery Bagley. Had need arisen for the transportation of projectiles or other heavy material, the post would have been almost helpless for nearly a week.

Other damage includes the washing away of much of the embankment around the cable tank; cutting away about 10 feet thickness of parapet at Battery Shipp; cutting into the advanced corner of parapet at Battery Bagley; flooding of magazines in Battery Swift, through drainage sump holes, to a depth of several inches; and the development of cracks in Battery Caswell, indicating a settling forward of the parapet and a probable disturbance of the platform level. Many wooden buildings of more or less importance were damaged to a greater or less extent.

A very serious feature is the removal by the storm of a very large quantity of sand wherever the water reached, resulting in a recession of the high-water line about 50 to 200 feet and a general reduction of level over the shaded area. The entire post is in consequence liable to still more serious damage in the event of a similar storm.

The railroad, wagon road, parapet, etc., can be restored for about $5,000; but they, together with the post generally, would be liable to worse damage in the event of another similar storm.

Decidedly the best remedy, which I strongly recommend, is the construction of a sea wall and the filling of all interior low places to the 12-foot level.

A sea wall 6,500 feet long, located as indicated on the blue print No. 2, constructed according to sketch plan thereon, can be built for about $60,000, and a sand embankment in rear, about 200 feet wide, for about $35,000 more. The interior fill would cost perhaps $65,000 additional.

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* Not printed.

The resulting available area would be none too large to properly accommodate the full garrison of three batteries necessary to properly man the post with its present armament and equipment.

I would also recommend the construction of a new wharf, as shown on blue print No. 2*, to replace the present two. The old wharf is unsafe and of little use without extensive repairs. The new wharf is on unprotected piles, now partially destroyed by the teredo, and must be entirely renewed in about a year, and the location of both wharves is so exposed that landings can not be made in rough weather. The proposed location is better protected than any other on the post where the channel can be maintained without dredging.

Finally, I would recommend a radical change in the location of communications, to new lines shown on blue print No. 2, at an approximate cost of $15,000 for railroad and $5,000 for wagon road, the former to have 50-pound rails and the latter 6 inches of broken stone and 4 inches of shell.

Such a change will result in a railroad in close touch with batteries and storehouses where most needed for heavy traffic, while the wagon road will pass along the rear of the post as remote as possible from all batteries and in the best location for ordinary needs of the post. Assuming such a change in the location of communications, the post commander and I have worked up what seems to us the best possible arrangement for the various buildings on the post, as shown by the rectangles marked A, B, C, and D.

This will result practically in running the line of railroad approximately along the boundary between the areas allotted for batteries and for post purposes, and will give what seems to be the most convenient arrangement of the post. Such a plan can be carried out as funds are allotted for the construction of new buildings without interfering with those now in use.

It is realized that the approximate estimates herein submitted are very large and that an allotment can not be made without serious consideration, but in my opinion the situation is a serious one, and the proposed remedy, especially as to a sea wall and embankment in rear, is believed to be the only method by which reasonable security can be assured for the expensive works and armament already in place, and such others as will be needed to complete the post. The Engineer Department has already expended on this post nearly half a million dollars, and the Ordnance Department about as much more, and the plain question that must now be faced is whether or not an additional expenditure of $150,000 to $200,000 should be made to secure the works already constructed from damage by storm.

It is not understood that the entire expense should be borne by the Engineer Department, as all of the interior fill is apparently within the jurisdiction of the Quartermaster's Department, which should also, it is thought, build the new wharf and wagon road.

Very respectfully,

E. W. Van C. Lucas,
Captain, Corps of Engineers, U. S. A.

Brig. Gen. John M. Wilson,
Chief of Engineers, U. S. A.,
Washington, D. C.

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*Not printed.

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 29, 1899.

Respectfully submitted to the Chief of Engineers, U. S. A.

PETER C. HAINS,
Colonel, Corps of Engineers, U. S. A.,
Division Engineer, Southeast Division.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 2, 1899.

Respectfully submitted to the Secretary of War, through the Quartermaster-General, United States Army.

A tropical storm of unusual violence along the South Atlantic coast during the latter part of October, 1899, caused extensive damage to public interests on the military reservation at Fort Caswell, at the mouth of the Cape Fear River, North Carolina. Upon this reservation are located the modern defenses designed for the protection of the Cape Fear River and the port of Wilmington, N. C. In the report herewith, Captain Lucas sets forth in detail the nature of the damage sustained and the remedies proposed by him for protecting the reservation against future storms of like character.

Owing to their location upon the highest grounds, the newly constructed batteries appear to have escaped serious injuries, the damages being confined principally to the communications, buildings, and wharf. Owing to the low and exposed site, the possibility of danger from severe storms has for some time been recognized by the Engineer Department, and the construction of a sea wall for the protection of the reservation has been under consideration. The storm of last October emphasizes the necessity for radical measures if the various public interests on the reservation are to be maintained and guarded.

The item of first necessity is a stable sea wall, inclosing the exposed portions of the site and carried to such a height as to prevent flooding of the reservation by extraordinary storm tides. Until the site has been thus protected all public improvements of every character will be in constant danger. Captain Lucas estimates the cost of a suitable sea wall at $60,000, and of the filling required behind the sea wall, and for low places in the reservation, at $100,000. The former work pertains properly to the Engineer Department and the latter to the Quartermaster's Department, but for purposes of economical execution it is desirable that the entire work should be executed by a single bureau. The value of the engineer work and ordnance property already on the reservation approximates $1,000,000, and it is understood that heavy expenditures will be required of the Quartermaster's Department for the accommodation of the permanent garrison. There are no funds at present at the disposal of this office for undertaking any portion of the work outlined, and, as the matter is urgent, it is recommended that the attention of Congress be invited to the subject, with request for a special appropriation of $160,000, to be expended in constructing a sea wall and for filling in at the reservation of Fort Caswell for its protection.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

[Third indorsement.]

WAR DEPARTMENT,
QUARTERMASTER-GENERAL'S OFFICE,
Washington, December 5, 1899.

Respectfully submitted to the honorable the Secretary of War, concurring in the recommendation of the Chief of Engineers, that the attention of Congress be invited to the low and exposed site and the possibility of danger from severe storms at Fort Caswell, North Carolina, with request for a special appropriation of $160,000, to be expended in constructing a sea wall and for filling in at the reservation.

As the sea wall would necessarily be constructed by the Engineer Department, it would seem better that all the work should be done by that Department. In view of the urgency of this work, and the necessity for preparing the site for necessary buildings as soon as possible, it is further recommended that in case of favorable action by Congress the funds be made available from the date of the passage of the act appropriating them.

M. I. LUDINGTON,
Quartermaster-General, U. S. A.

REPORT OF MR. CHARLES SCHUSTER, SUPERINTENDENT.

Preservation and repair of fortifications.—The following repairs and alterations were made at the 8-inch battery:

The 8-inch disappearing rifles, Nos. 1, 2, and 3, being reported as considerably out of level, authority was granted to relevel these guns.

Gun No. 1 was lifted out of the trunnion bed and supported on blocking, as was also the carriage, to a sufficient height to allow the adjusting and releveling of the base ring and the renewing of the cement grouting under the ring.

This carriage is of the model 1896.

After the cement grouting was sufficiently hardened the gun and carriage were again lowered and adjusted.

Guns Nos. 2 and 3 having carriages of model of 1894 were releveled by means of the leveling screws on the base ring and the traverse circles entirely taken up and releveled.

Owing to the settlement of this battery all of the guns mounted there will have to be entirely dismounted and readjusted when settlement stops.

The cost of this work was:

For Gun No. 1	$86.82
For Gun No. 2	29.65
For Gun No. 3	25.35
Total	141.82

The drainage in this battery leading through pipes placed in the floors to the sand below proved insufficient. Letter of the Chief of Engineers, dated August 22, 1899, granted authority to apply certain remainders of divers allotments to the improvement of the drainage system of this battery. Consequently an entire new drainage system was laid, lines of 6-inch terra-cotta pipe being laid under the floors and leading through the passages and shot rooms to the main sewer in the rear of the battery, this line having branches leading to the magazines, shell rooms, pits under lifts, and storerooms.

The new system works satisfactorily.

The doorsills of the outside and inside doors were raised 2 inches each to exclude water from the interior of the emplacements, which formerly entered under the doors in heavy rains.

Corrugated iron awnings were placed over the lift doors on the gun platforms.

The cost of the entire work authorized by letter above referred to was charged to—

Installing storage battery	$41.95
Mounting 12-inch guns	153.00
Contract work	251.31
Preservation and repair	550.00
Total	996.26

The slopes leading from the terreplein to the floors of this battery were originally turfed. In heavy rains the water would undermine the turfing and carry the sand to the lower level and choke the sewers. The turfing has been removed and the slopes covered by a layer of concrete 4 inches thick. This has obviated all previous trouble caused by water and has improved the appearance decidedly.

The cost of this work was—

For Emplacement No. 2	$58.63
For Emplacement No. 3	45.18
For Emplacement No. 3	37.94
Total	141.75

At the 12-inch battery it was found that one of the drains leading from the superior slope through the masonry to the cisterns in the rear of the battery had become choked and could not be cleaned. Consequently the water would wash out and gully the parapet in front. By authority granted in letter of the Chief of Engineers, dated July 26, 1899, this was remedied by putting a covered drain from the superior slope through the parapet to the foot of the exterior slope.

The cost of this work and material was $28.26.

Torpedo material has been cared for, the instruments examined, carefully cleaned, and replaced in air-tight cases.

The oil engine in the casemate was dismounted, the finished parts painted with white lead and tallow, and stored in boxes in the torpedo storehouse.

Other work under this appropriation has consisted of placing new brass hasps and staples and new heavy padlocks on the doors of the 8-inch battery, making minor repairs to trolley blocks and lifts, repairing cracks in concrete, and other repairs.

Installing ammunition lift in 4.7-inch rapid-fire emplacement.—The lift is a double-platform lift similar to the lift installed for a like gun at Baltimore, with the difference that the lift built for the emplacement at this post was widened and so altered as to hoist two charges of shot and shell at each elevation of a platform.

Since the installation a trial of the lift was made by the commanding officer with the regular detachment of enlisted men, and it was found that the lift supplies more ammunition than can possibly be used in the same time.

A drawing of the lift is forwarded herewith.

The cost has been as follows:

Cost of lift	$335.00
Cost of installing lift	170.69
Total	505.69

A temporary wooden house, sliding to the rear on iron track when not in use, has been placed over the lift. This should be replaced by a more permanent one of sheet iron.

Mounting eight 12-inch steel mortars.—At the beginning of the fiscal year nearly all parts of seven carriages had been transported to the site. (See Annual Report of the Chief of Engineers for 1899, vol. 1, p. 856.)

During the fiscal year the mounting of the eight mortars has been completed.

The total cost of mounting these guns, including concrete for foundations, was $2,025.52.

Constructing mortar battery for eight 12-inch steel mortars.—At the beginning of the fiscal year the status of this work was as follows:

The masonry in the battery was completed. Floors were laid. Trolleys were placed. Electric service was installed.

Four mortar pits were finished. Windows and frames were finished. Twenty-nine thousand cubic yards of sand were placed in parapet and 1,800 square yards of turfing laid. Piles were driven and cut to grade in the remaining 4 pits and 2 base rings ready to be concreted in.

The western lookout was completed.

For detailed report see Annual Report of the Chief of Engineers for 1899, Part 1, page 854.

During the fiscal year this battery has been completed.

Below is an itemized list of the cost of different classes of work for the completed battery:

	Labor.	Material.
Plant:		
Purchase	....	$1,260.96
Repairs	$2,198.25	....
Maintenance	1,110.24	....
Transfer	3,802.70	....
Total	8,730.60	1,260.96
Building material:		
Lumber	....	1,300.90
Crushed granite	....	444.64
Broken stone	....	16,290.22
Large broken stone	....	1,385.25
Portland cement	....	16,977.50
Rosendale cement	....	5,324.01
Sand for concrete	611.60	....
Delivery of all material, including freight	7,869.66	....
Miscellaneous material	....	8,469.08
Total	8,481.26	50,191.60
Manufacture of concrete:		
Charging and running mixer	1,767.10	....
Delivery on wall	1,547.77	....
Placing and tamping	2,150.47	....
Total	5,465.34	....
Plastering and floors	1,069.85	....
Making forms	3,733.41	....
Granolithic finish	532.43	....
Pavements	488.30	....
Brickwork	529.91	....
Excavation	1,238.64	....
Fill in parapet	7,176.61	....
Turfing	2,051.65	....
Electric service	5,133.24	....
Superintendence	7,658.02	....
Expenses of steamer	....	2,629.81
Miscellaneous	4,875.58	143.83
Total	34,787.64	2,773.64

Total for labor	$57,464.84
Total for material	54,226.20
Total cost of battery completed	111,691.04

General.—All footings under interior walls of mortar battery were increased in width to such dimensions that each square foot of foundation under the traverses should bear an equal weight, as nearly as possible.

All forms for rooms, including ceilings, were put on the footings complete. By this means the concrete for the narrow walls could be dumped where wanted directly from the skips, thus avoiding handling of the concrete in placing.

During the construction of 8-inch-rifle battery by contract work at this post special attention was paid to have the contractor mix the concrete as dry as possible, 27 to 37 gallons of water being used per cubic yard, the quantity of water being regulated by the quantity of moisture in the sand. The concrete, after being placed, was tamped with 12-pound tampers until water appeared on the surface. Afterwards, when contemplated changes necessitated the removal of certain parts of this structure, the vertical cuts through the concrete revealed the fact that in each batch of concrete placed the stone in the concrete was pounded to the bottom, bringing the mortar to the top, so that the face of the cut showed alternate strata of rock and mortar. To avoid this in other structures, more water was used in concrete, the quantity being altogether regulated by judgment, the guide being the moisture contained in the sand.

After a heavy rain the concrete would require probably 50 per cent less water than it would in hot, dry weather.

At all times the mortar in the concrete was about of the consistency of mortar used by brick masons. Another very serious objection to dry concrete is the fact that, when delivered in skips to the site by rapidly swinging derricks and dumped from a height of, say, 6 or 8 feet, the loose stone in the concrete will roll to the edges of this dumped heap, the mortar remaining in the center, and, unless the batch is very carefully handled and partly remixed, this loose stone at the edges is apt to be packed in the wall and the voids between the stones never filled. If the loaded skips are lowered on the concrete already placed, they will unhook automatically, and when the hoisting engine is again started the mass of concrete will slide out of the skip in the same condition as it came out of the mixer, ready for leveling and tamping. Less tamping is necessary.

In constructing the mortar battery great care was taken to make each layer of concrete about 8 inches thick and to carry the layers continuously all around the traverse. The boards on the forms formed an excellent guide for this method.

Each course was kept an inch or two higher in the center of the structure, sloping gently to the outside walls, the object being that should horizontal cracks develop afterwards they would drain to the outside. Subsequent developments have proved the wisdom of this method.

In placing the granolithic finish against the forms for outside walls it was found that tamping on the top of the mass only would leave the exterior face pitted by small bubbles. This was effectually remedied by using a stick about 1 inch by 2 inches by 2 feet to pack the mass against the form, letting the stick penetrate well toward the bottom of the layer, and using no tampers.

The ceiling beams in the eastern and middle traverses of the mortar battery are set in the concrete so that their lower flanges are exposed to the air. The beams in the western traverses are buried in mortar, those in the smaller rooms and powder magazines having their lower flanges covered by 2 inches of Portland-cement mortar. The beams in the shell rooms were placed 6 inches above the ceiling level to allow the trolley beams to be set in the slots or recesses left in the ceiling. (See fig. 1 on accompanying drawing.)

It was feared that there would be a plane of weakness in line AB of insufficient strength to support the weight of the body of concrete marked C. To reenforce this a lot of iron barrel hoops obtained from Portland-cement barrels were bent into oval shape and hooked into the cement mortar while still soft. They were placed as close as possible, say 6 to 8 per square foot, and the concrete above the mortar well worked into the hoops. Special care was also taken to complete this work from the ceiling forms to the thickness of 2 feet in the same day, so as to procure a solid structure without seams.

The difference of these two methods is well illustrated in this battery. While in the eastern and middle traverses the beams are dripping with moisture on warm days, the ceilings in the western traverse are dry. That the strength of the structure is sufficient is shown by the fact that the traverse has a transverse vertical crack nearly in the middle of the traverse, but very careful examination shows not the least sign of cracks along the line AB.

As soon as possible all forms were removed while the concrete was still moist. The small ridges protruding at the lines of joints in the forms were scraped off and the walls coated with a thin grouting of Portland cement. After coating, the walls were scraped immediately with a plastering trowel, the object being to fill all small pits and holes, but leaving no coating in the wall where the wall was smooth. A light finishing touch with a wet brush completed the finish, which, when dry, has the appearance of a plastered wall, without having a coat of plaster on it which would subsequently peel off.

In the construction of the foundations for mortars the following methods were employed: The outside circular forms for the concrete were placed before the battery was built, the pits being only partly excavated and the staves or sheet piling being driven 18 inches below the proposed bottom level of the concrete. After the foundation piles were driven and final excavation started it was found that when the water was pumped from the pit the outside pressure was too great (4 feet head) and would break through under the staves. Additional planks were therefore driven down by water jet 8 feet lower than the old forms, the upper ends being nailed to the inner face of the original forms. This answered the purpose. The foundation piles were then sawed off at the required grade. The base ring of the mortar carriage was moved in position over the pit and slung by four chains to two beams laid across the pit. The holding-down bolts, with their washers attached, were put in their places in the ring, and the whole was then put in exact position and approximate level, after which the concrete was placed. No templets for bolts were used. A steam pump with 3-inch suction was used to keep the pit free of water. When the placing of concrete was started it was thought that the placing of the first concrete against the forms would exclude the flow of water from the pit. This was a complete failure, because the water would break through the concrete in small streams, washing out the mortar and leaving the bare stone. The concrete was then started in the middle of the pit and worked spirally toward the outside. A good solid mass of concrete was the result.

In the dividing wall of the rooms designated on the type drawing for mortar battery as "Dynamo room" and "Relocating room" a two-flue chimney was built, having a fireplace in each room. A water closet, with four bowls for enlisted men and one for officers and one urinal, was built in the western parapet, with door and window opening through the retaining wall.

The relocating rooms, dynamo room, and closet were provided with windows 3 by 4 feet.

Several forms of observing stations have been placed in the batteries of this post, that shown on the accompanying drawing (fig. 2) giving best satisfaction, strictly on account of convenience to observer and enlarged field covered by the instrument.

Cracks.—Every emplacement for heavy rifles at this post has developed a serious crack in the gun platforms leading from over main entrance across the platform and along the breast wall.

These cracks seriously impair the utility of the shot room and the rooms beyond in the line of the cracks. Numerous expedients were tried to fill these cracks; among others, they were calked with oakum, filled with neat cement grout, semiliquid white-lead paint, linseed oil boiled to a viscous consistency, and asphalt dissolved in naphtha. All of these methods have proved to be failures, more or less. On the one hand, liquids or semiliquids are liable to be absorbed by the porous concrete until they become too stiff to adjust themselves to the ever-varying width of the crack caused by expansion or contraction of the concrete. On the other hand, certain mixtures which will retain their fluidity at a certain temperature will congeal at low temperatures when the cracks are largest and fluidity most desirable and necessary. Solid substances will not answer because, the crack giving a plane of least resistance, a new crack will always develop by the next contraction, when the contraction is more than it was at the time the crack was filled. Elastic substances will lose their elasticity sooner or later under exposure to moisture and chemical action when in contact with cement. After careful study of the subject the following scheme was applied and tried and found to be a perfect success so far:

A score or channel about 8 inches wide was cut in the platform in line with crack (see accompanying sketch, fig. 3), care being taken in cutting the score to have the bottom form a ridge, the apex directly over the crack G. At the beginning of the crack this apex should be at least 1 inch below the level of the platform and gradually descend at a slope of about 1-100 until an outside wall is reached. After this is cut out the débris should be carefully removed. The ridge AB may be smoothed with a light coat of Portland-cement mortar. Then a coat of asphalt dissolved in naphtha should be applied with a brush. A sheet of lead, F, as wide as the original cut, should then be placed and shaped over the ridge and carefully and closely laid over the ridge. Should the crack be longer than the length of lead available, other strips of lead should be added and the joints soldered. After the lead is in place, take two round iron rods one-half inch in diameter and 2 feet long, bent at one end for manipulating (fig. 4), and place them in the angles of the score at A and B, after which fill and tamp with Portland-cement mortar mixed fairly dry and finished on top level with the original surface; then carefully turn the rods back and forth on their axes by means of the bent handles and carefully withdraw partly. Continue to place the mortar until the outside wall is reached, when the rods are withdrawn completely. Sooner or later it will be found that a new crack will develop at either DA or EB, but all water admitted in this new crack will be carried off by means of the little drains at A or B, leaving the original crack protected and dry.

Cracks in angles of vertical walls and platforms may be treated in a similar manner, as shown in fig. 5, only one drain being used in this instance. Cracks in vertical face walls can be treated as shown in fig. 3, but it will be necessary to place a wide smooth board over the score as a form to hold the mortar, as the mortar must be sufficiently stiff to prevent the collapsing of the drains when the rods are withdrawn.

Plant.—(For details, see Annual Report, Chief of Engineers, 1899, Part I, p. 851.)

All material was delivered at the wharf on floating plant.

Stone was transported partly in deck scows, but chiefly in the hold of the large barge which had been a barkentine, having a capacity of over 600 tons. The difference in cost of unloading was about 2½ cents per cubic yard in favor of the deck scows.

Cement was brought from the factory in schooner cargoes.

Storage facilities were provided for 7,000 barrels of cement and 3,000 tons of broken stone. This permitted the delivery of material in cargo lots and insured enough reserve material to avoid stoppage of work for lack of material. The derrick on wharf was an ordinary stiff-leg boom derrick, which handled about 250 tons of stone in a day of eight hours.

Gauge of track was 3 feet, capacity of side-dumping cars 2½ yards. One Porter locomotive, 9 by 14 inch cylinders, was used for heavy hauling, and another, 7 by 12 inch cylinders, for light hauling and on temporary tracks.

The stone and sand bins used here were of three different styles, the first one, for the construction of the 8-inch gun battery, having a capacity of 800 tons and a single tunnel for cars underneath.

About 75 feet beyond the end of the tunnel was the mixing apparatus, two cubical mixers being used. Between the mixers and the tunnel was the inclined track, having a switch to allow the tunnel cars to be brought to mixers Nos. 1 and 2, alternately. This arrangement was slow and unsatisfactory, the best day's work done by the contractor being 120 cubic yards in ten hours, and the average about 70 yards.

Another objection was the use on the mixers of friction clutches on the intermediate shafts. They frequently broke down and caused various delays.

For the construction of the 12-inch gun battery a larger stone bin was built, the capacity being 3,000 tons of broken stone. This bin had two tunnels, separated from each other by only a row of stanchions, the elevated trestle being directly over the tunnels. While this arrangement was a vast improvement on the first, it necessitated a considerable amount of trimming of stone in the bin when the supply was low.

An independent track led from each tunnel direct to the corresponding mixer. The same mixers were used on this work, but the friction clutches and stationary engines were discarded and the mixers driven by a double-drum hoisting engine. Fourteen-inch belts led over the hoisting drums, which were lagged with wood for better friction, to intermediate shafts, which latter were geared to the mixer shafts at 1 to 3½.

With this arrangement the mixers were under the perfect control of one man. The maximum output was increased to 204 yards in ten hours, averaging 129 cubic yards per day.

For the construction of the mortar battery the capacity of these stone bins was the same (3,000 tons), but the tunnels below the line were spaced far enough apart to bring the tunnels directly under the dump of the cars, thus avoiding the trimming in the bin. A sectional drawing of this arrangement is forwarded herewith (fig. 6.)

An extension of the stone bin, 25 feet long, was used for sand bin, and beyond the bulkhead of this bin was the platform and hoppers for cement.

The tunnel cars were built to hold the necessary quantity of material to make 1 cubic yard of concrete. In lowering the cars they would first receive the stone, then the sand, and finally the cement. This would put the cement on top of the load, exposed to the wind and liable to be shaken off the car by the jolting the car would receive in transit. On windy days the cement dust would blind the men on the mixer platforms.

It would have been a far better arrangement had the cement platform been between the sand bin and the stone bin; then the sand would have covered the cement in the cars, and, at least in a measure, mitigated the loss of cement and nuisance of blowing cement. The cement shed was built close to and parallel with the stone bin.

The arrangement of the mixers was practically the same as that used for the 12-inch gun battery. The maximum day's work was 220 cubic yards in eight hours.

The derricks used were the ordinary derricks, with masts and boom 72 feet long. The booms were swung by 1-inch ropes operated by the gypsy heads on the hoisting engine. The derrick engines were Lidgerwood double-drum, 8¼-inch by 12-inch double-cylinder engines. The three derricks used were so placed that they covered the site of two traverses completely and partly the site of the third traverse. Four derricks would have been better, as all the site would have been covered. As it was, the eastern and middle traverses were built first. The derricks could be worked very rapidly and permitted the placing of concrete in continuous layers all across the work under construction, as near as possible in the manner of coursed masonry. One derrick was able to dispose of the output of both mixers, while the others were used alternately to hoist and place large rubble stone.

A well-equipped shop was found to be of great assistance and help to the work. The shop used here was equipped with a good forge, full set of blacksmith's tools, stocks and dies, drill press, brass foundry, emery wheels; and under a shed adjoining the shop a bandsaw and ripsaw table. A small engine and boiler furnished power for the blower used for forge and foundry, saws, emery wheels, etc. There was employed permanently a good blacksmith, who was also a machinist and helper. When no blacksmith work was to be done the men would work on casting or finishing brass work. In this way all metal work and repairs to plant were done on the work.

For the circular and curved forms the bandsaw was of great use.

Drainage.—In the first battery constructed here the drains simply led to the sand through 3-inch vitrified pipe. This proved a failure, and a new drainage system has subsequently been put in this battery. (See beginning of this report under heading "Preservation and repair of fortifications.") All batteries built subsequently have positive drainage to sewer. Special attention was paid to drainage of water off the floors to the drain. This was accomplished by raising the center of the floor so that water will run to the sides of the floors, where a small gutter 3 inches wide and from nothing to three-quarters of an inch deep conducts the water to drains. The general slope used on floors was 1 on 100. This system does not permit the water to collect in the middle of the floor, and keeps the floor dry where most used.

The drains from the mortar pits lead by a common pipe to a manhole in the rear of each group. This arrangement necessitates angles in the line of drains, and it has since been found that the sand which is blown in the pits is afterwards carried by rain water into the drains, choking them. A light rain and small quantity of water will not force the sand through the drains to the manhole, but a heavy rain, and consequently a good head of water, will clear them. A better plan would probably have been to place the manhole in the center of the gun platform, permitting the use of shorter drains without bends.

Another very serious trouble is caused by the use of vitrified pipe leading from the open drains on the superior slope through the mass of masonry to the cisterns in the rear.

In one instance, at least, the line of pipe was broken by the settlement of the battery, thus allowing the water to be distributed through the cracks in the masonry. This drain has been closed, and the water is now conducted through an iron pipe placed against the masonry on the outside.

Lighting.—(See Annual Report, Chief of Engineers, 1899, Part 1, p. 859.)

All batteries are lighted by electricity.

The current is conducted from the central station by overhead bare copper wire to the batteries. The 12-inch, 8-inch, and mortar batteries have each a storage battery of sufficient capacity to light the battery for eight hours. The interior wiring is of insulated wire fastened by porcelain cleats to the interior walls and conducted from room to room through vitrified pipe placed in the dividing walls. A cast-iron receptacle for each lamp is placed in the concrete of the ceiling. Sixteen-candlepower lamps are used. The wiring is arranged to light each emplacement separately, the magazines and shot rooms having special circuits.

At the mortar battery a line of 6 inch vitrified pipe through the entire length of the front retaining wall, 84 feet long, carries the wires from one traverse to the next. In one of these conduits the line which was placed in the pipe was found missing. After repeated and fruitless efforts to get the wire through, a large rat was caught, a light cotton string tied to his hind leg, and the rat put in at one end of the conduit. The rat ran about halfway and stopped. A quantity of paper was put in the pipe and set on fire, but this burned the string. However, the end of the string was in reaching distance, so that the rat could be pulled back and the process of smoking repeated, this time the string being covered with sand. The smoke was driven slowly through the pipe by fanning. This forced the rat through the pipe, and he was found hanging at the other end of the conduit. By means of this light string a heavier one was pulled through, and finally the wires.

Damage by storm.—On October 30, 1899, a heavy northeast gale blew during the afternoon and night till about midnight. Soon after midnight the gale shifted to southeast, causing a heavy sea and the water to rise to 10.7 feet above mean low water.

The following damage was done to reservation and batteries:

The old wharf was covered by water and undermined near the shore end. The railroad and all connections with the wharf were washed away for several hundred feet. All timbers, coal, engine house, and everything movable or floatable were lost.

The new wharf was left in good condition, except that the shore connection, the railroad embankment, trestles, and the railroad washed away for about 150 feet.

Farther up the line of the railroad were several washouts, the largest and worst being near the old flood gate; beyond the mortar battery the railroad embankment was completely washed away.

The wagon road from the wharf to the torpedo storehouse was ruined and partly washed away, a large washout being near the entrance to the engineer office. The embankment of the railroad between officers' quarters and the hospital was more or less damaged all along, the worst damage being near the culvert, where the embankment was completely gone for 75 or 100 feet. Beyond this washout the embankment was all washed away to the fill lately made. The road from the mortar battery to the 5-inch battery was completely gone to the level of the adjoining land.

All temporary houses on the reservation belonging to the Engineer Department were wrecked.

The embankment around the cable tank was washed completely away for more than half its length.

The parapet of the mortar battery was partly washed down on the front face.

The parapet of the 5-inch battery was much washed.

The large derrick at the mortar battery fell, and in falling struck the mortars and broke.

The beach broke through in six places, and everything below grade of twelve was flooded, washed, and damaged.

The launch *Daisy*, which was lying on blocking on shore, was washed down the beach and sustained slight damage.

A considerable loss of tools, etc., was sustained.

As soon as possible after the storm a survey of the reservation was made and map submitted.

Since then the railroad and wagon road have been repaired.

The parapet of the 5-inch battery has been restored at a cost of $425, this amount being taken from the amount allotted for constructing this battery and mounting the gun therefor.

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DEFENSES OF THE COAST OF SOUTH CAROLINA.

Officers in charge, Maj. Ernest H. Ruffner, Corps of Engineers, until May 7, 1900, and Capt. James C. Sanford, Corps of Engineers, since May 7, 1900; assistant, Lieut. Edward H. Schulz, Corps of Engineers, until October 16, 1899; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

CHARLESTON HARBOR, SOUTH CAROLINA.

Mortar battery.—For history prior to June 30, 1896, see pages 508–513, Annual Report for 1896.

Settlement has almost ceased. The total settlement, from the beginning to November 1, 1899, was 1.66 feet at the south end of the main gallery, 1.49 feet at the north end, and 1.47 feet in the middle. Between May 5 and November 1, 1899, there was an average settlement of about 0.02 of a foot. During the past year wooden box drains leading down the slopes were substituted for open wooden V-drains, and some grading was done to lead the rain water into these box drains. The floors of both magazines were raised about one foot. The surfaces of these new floors were given slopes from their inner ends to the doorways, which are near the main drains, so that water getting into these magazines in possible hurricanes may readily find its way out. These floors are now higher than the highest recorded tides, except two. A wire fence with good cedar posts was built around three sides of the reservation, the fourth side being in a marsh. Plain wire was used along street lines, to meet the requirements of local laws. The outlet drain, which was of 10-inch vitrified pipe, was replaced by 15-inch vitrified pipe to give free outlet to storm water running in from the pits and prevent the backing up of the water and consequent flooding of floors. The settlement of the battery caused an inward slope in the floor of the dynamo room, and consequently the drippings at the doorway and water from the boiler ran back into the room and passage leading to the relocator room. The floor of the room was raised and given an outward slope to correct this. Mortar No. 15 was found to be slightly out of level by a machinist of the Ordnance Department. It was leveled by wedges, and grout was forced under the bottom of the base ring, by the Engineer Department. Some minor repairs were made to the machinery in the dynamo room and electric-lighting plant. The slopes of this battery, which were planted with joint grass in 1899, are now in good condition, being well covered with grass.

This battery of 16 mortars is complete and is in charge of the artillery. All the above work was done under the appropriation for "Gun and Mortar Batteries," of which there was a considerable balance from the total allotments, excepting the repairs to machinery and other work in the dynamo room, and the construction of the fence. These items were charged to the allotment from the appropriation for "Preservation and Repair of Fortifications" for the fiscal year ending June 30, 1900.

Total allotments for this battery	$179,000.00
Total expenditures to June 30, 1900	178,338.52

Money statement.

July 1, 1899, balance unexpended	$2,576.08
June 30, 1900, amount expended during fiscal year	1,914.60
July 1, 1900, balance unexpended	661.48
July 1, 1900, outstanding liabilities	50.68
July 1, 1900, balance available	610.80

Preservation and repair of fortifications.—Some repairs were made to electric-lighting plant at the mortar battery, the floor of the dynamo room was raised, and a fence built around three sides of the reservation. These are described in the report for the mortar battery.

At the 10-inch battery some broken brackets of shot lifts were replaced. Hoods of yellow metal were flashed in over the doors of the shot lifts and the entrance to the dynamo room, and some work was done upon grooves over other doors. These are designed to keep rain water from running into the battery at the doors. The holes at the bottoms of the lift wells were filled with cement mortar, to prevent water from springing in these wells. Some work was done on the oil engine, and piping was laid to connect it directly with the artesian well. This last was done to secure a better supply of water for cooling purposes, as the well points were found insufficient. The concrete gutters for collecting water from the parapet were repaired. An attempt was made to stop the leaking of one of the magazines by cutting out the cracks above it, which occurred at division planes, and pouring in grout. The trenches cut out were afterwards refilled with cement mortar. This seemed at first to be successful, but recently the magazine has leaked as badly as ever. It seems probable that the cracks have again opened on account of slight settlement.

Money statement.

July 1, 1899, balance unexpended		$619.78
April 4, 1900, amount allotted	$500.00	
June 9, 1900, amount allotted	3,300.00	
		3,800.00
		4,419.78
June 30, 1900, amount expended during fiscal year		756.13
July 1, 1900, balance unexpended		3,663.65
July 1, 1900, outstanding liabilities		358.06
July 1, 1900, balance available		3,305.59

Preservation and repair of torpedo material.—The sum of $500 was allotted August 24, 1899, for the preservation and repair of torpedo material at Charleston, S. C.

The apparatus in the casemate was taken down, cleaned, wrapped in paper, and brought up to the custom-house in Charleston, where it was stored in one of the rooms on the upper floor connected with the United States Engineer Office.

A dust-proof room, 20 feet by 20 feet and 10 feet high, was built in one of the warehouses for torpedo material. A wooden tank, which had been used in construction work, was taken down and reerected near the torpedo cable tank. In this two of the drums of cable, which were not completely covered in the cable tank, were placed, and the tank filled with water so as to cover these drums.

Mines, anchors, shackles, etc., were heated and coated with Stockholm tar. The mines were plugged and painted where necessary. Tools and some of the delicate instruments were overhauled and cleaned.

Money statement.

August 24, 1899, amount allotted	$500.00
June 30, 1900, amount expended during fiscal year	338.08
July 1, 1900, balance unexpended	161.92
July 1, 1900, outstanding liabilities	156.83
July 1, 1900, balance available	5.09

Three emplacements for 15-pounder rapid-fire guns.—For history of this battery prior to June 30, 1899, see Annual Report for 1899, page 861. Nothing was done during the fiscal year, as neither the guns, carriages, nor base castings have yet been received.

Total allotments for this battery	$9,500.00
Total expenditures to June 30, 1900	9,390.79

Money statement.

July 1, 1899, balance unexpended	$109.21
July 1, 1900, balance unexpended and available	109.21

Emplacement for 6-inch rapid-fire gun on disappearing carriage.—For history prior to June 30, 1899, see page 862, Annual Report for 1899.

This emplacement was completed during the fiscal year. About 1,100 cubic yards of concrete were placed in the walls of this emplacement, and 2,400 cubic yards of sand were put in the parapets. All the sand slopes were covered with marsh mud. The carriage has been received during the year, and has been mounted by the artillery. The gun has not been received. The hole at the bottom of the counterweight well was enlarged to give better drainage. The battery, consisting of the above-described emplacement and one 6-inch gun on pedestal mount, has been turned over to the artillery. There remains some minor work, such as the erecting of hand railing, which will be done after the gun is mounted.

Total amount allotted for this battery	$20,000.00
Total expenditures to June 30, 1900	19,118.07

Money statement.

July 1, 1899, balance unexpended	$12,176.07
June 30, 1900, amount expended during fiscal year	11,294.14
July 1, 1900, balance unexpended and available	881.93

Mounting two 12-inch guns and carriages.—The 12-inch rifle for the disappearing carriage was received and mounted.

The battery was turned over to the artillery.

Total amount allotted for this work	$1,600
Total expenditures to June 30, 1900	1,600

Money statement.

July 1, 1899, balance unexpended	$283.45
June 30, 1900, amount expended during fiscal year	283.45

Electric-lighting plant, 12-inch battery.—For history of work prior to June 30, 1899, see page 864, Annual Report for 1899.

Under the contract of J. F. Buchanan & Co., of Philadelphia, Pa., the electric-lighting plant was installed, tested, and accepted in November, 1899. The boiler and piping were supplied and set up by the United States. This plant consists of a direct-connected dynamo of 10 kilowatt capacity, made by the General Electric Company, which serves to light sixty 16-candlepower 110-volt incandescent lamps. Provision has been made for a storage battery, but none has yet been installed. There are two switchboards with a full complement of measuring and controlling instruments for both lighting the battery and for firing the guns.

The plant was turned over to the artillery in May, 1900.

Total amount allotted for this work	$5,000.00
Total expenditures to June 30, 1900	3,015.58

Money statement.

July 1, 1899, balance unexpended	$5,000.00
June 30, 1900, amount expended during fiscal year	3,015.58
July 1, 1900, balance unexpended and available	1,984.42

Preservation and repair of fortifications.—The sum of $200 was allotted June 9, 1899, and $300 June 9, 1900.

Guard rail was completed, cranes were erected, and wooden sheds were built over passages to keep out rain.

Money statement.

July 1, 1899, balance unexpended	$200.00
June 9, 1900, amount allotted	300.00
	500.00
June 30, 1900, amount expended during fiscal year	160.00
July 1, 1900, balance unexpended and available	340.00

Mining casemate.—For history prior to June 30, 1899, see page 865, Annual Report for 1899.

About 200 cubic yards of sand were placed in cover, and slopes were covered with about 200 cubic yards of marsh mud. Wooden backing strips were put up, and some oyster shells were placed in passage leading to this casemate.

Total amount allotted for the work	$1,900.00
Total amount expended to June 30, 1900	1,900.00

Money statement.

July 1, 1899, balance unexpended	$115.69
June 30, 1900, amount expended during fiscal year	115.69

PORT ROYAL, S. C.

Ten-inch battery.—For history prior to June 30, 1899, see page 705, Annual Report for 1898, and page 865, Annual Report for 1899.

At the beginning of the fiscal year the three emplacements were completed and two carriages had been mounted. The remaining carriage and the three rifles were mounted by the artillery under the supervision of an overseer employed by the Engineer Department. All cranes were erected. Hand railing was put up around the loading platforms of the three emplacements. A barbed-wire fence was erected around the battery to keep cattle off the slopes. Under the contract of J. F. Buchanan & Co. an electric-lighting plant was installed, tested, and accepted in November, 1899. This consists of a 10-kilowatt direct-connected dynamo of the General Electric Company, which serves to light sixty-seven 16-candlepower 110-volt incandescent lamps. Provision has been made for a storage battery, but none has yet been installed. The boiler and pump and their connections were supplied and erected by the United States. There are two switchboards with a full complement of measuring and controlling instruments for both lighting the battery and firing the guns.

The battery has been completed and turned over to the artillery, excepting the electric-lighting plant.

Total amount allotted for this work	$139,000.00
Total amount expended to June 30, 1890	124,014.09

Money statement.

July 1, 1899, balance unexpended	$21,435.41
June 30, 1900, amount expended during fiscal year	6,449.50
July 1, 1900, balance unexpended	14,985.91
July 1, 1900, outstanding liabilities	149.63
July 1, 1900, balance available	14,836.28

Cable tank.—For history prior to June 30, 1899, see page 869, Annual Report for 1899. During the fiscal year the drums of cable were removed from the tank, tested, insulated, and replaced in the tank. The main water supply is obtained from the roof of the cement shed. The pump used for the electric-lighting plant was also connected with this tank, and any loss from evaporation can be supplied by this pump.

Total amount allotted for this work	$3,000.00
Total expenditures to June 30, 1900	2,662.78

Money statement.

July 1, 1899, balance unexpended	$846.14
June 30, 1900, amount expended during fiscal year	508.92
July 1, 1900, balance unexpended and available	337.22

Renewing wharf.—An allotment of $2,500 was made from the appropriation for "Preservation and Repair of Fortifications," act March 3, 1899, for repairs to wharf.

The unprotected supporting piles of this wharf were replaced by piles protected by yellow metal. The superstructure was repaired where found necessary. The work was done by hired labor, using United States plant. The pile-driver frame was built on the ground, and a 4,000-pound hammer, which had been used in the fortification work at Charleston, was sent for use on this work. There were driven 126 protected piles, and the lumber used was from that which had already served for construction purposes.

Total allotment for this work was	$2,500
Total amount expended to June 30, 1900	2,500

Money statement.

July 1, 1899, balance unexpended	$2,500.00
June 30, 1900, amount expended during fiscal year	2,500.00

Preservation and repair of torpedo material.—The sum of $500 was allotted August 19, 1899, from appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to be applied to the preservation and repair of torpedo material at Port Royal, S. C.

The torpedo material was cared for during the year, and some repairs were made to the shed of the torpedo storehouse. The plugs and junction boxes were painted, and all screw threads were coated with white-lead-tallow mixture. All delicate instruments were overhauled, cleaned, and wrapped in paper. The cables in the cable tanks were rearranged so as to be covered without having the sills of the house always wet.

Total amount allotted for this work	$500.00
Total amount expended to June 30, 1900	98.62

Money statement.

August 19, amount allotted act March 3, 1899	$500.00
June 30, 1900, amount expended during fiscal year	98.62
July 1, 1900, balance unexpended	401.38
July 1, 1900, outstanding liabilities	68.46
July 1, 1900, balance available	332.92

Establishment of a bench mark.—For this purpose the sum of $200 was allotted March 7, 1900, from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899.

The mean low-water plane was transferred from the batteries to the selected site by gauges read simultaneously at both localities. These gauges were connected by levels with bench marks at both places. The elevations of three bench marks were computed, and the results furnished to the contractor for erecting the emplacement and mounting the dynamite gun at this point.

After all accounts were settled the balance was turned into the Treasury.

Total amount allotted for this work	$200.00
Total amount expended for this work to June 30, 1900	143.45

Money statement.

March 7, 1900, amount allotted		$200.00
June 30, 1900, amount expended during fiscal year	$143.45	
April 12, 1900, balance deposited to credit Treasurer United States	56.55	
		200.00

Sites for fortifications and seacoast defenses.—Prior to June 30, 1899, four lots of 10 acres each had been purchased. Three of these were on the water front and one immediately in rear of the middle lot of these three.

With an allotment of $300 from the appropriation for "Sites for

Fortifications and Seacoast Defenses," act of May 7, 1898, lot No. 6 was purchased, and with a further allotment of $25 from the same appropriation, the necessary papers were recorded and other incidental expenses paid.

On April 19, 1899, the United States attorney for this district was directed by the Department of Justice to take steps toward the purchase of lots 5, 12, 58, and 59. Lots 58 and 59 were condemned, the value being fixed at $700 for the two lots. An allotment of $700 was made June 21, 1900, for payment. Lots 5 and 12 were also condemned, the assessed value of lot No. 5 being $600, that of lot No. 12 being $1,950. The excessive valuation of lot No. 12 was due to the large valuation claimed for several leases of portions of the lot. No allotment has yet been made for the purchase of these lots.

Total amount allotted	$2,175.00
Total amount expended to June 30, 1900	1,455.25

Money statement.

September 8, 1899, amounts allotted	$325.00
June 25, 1900, amounts allotted	700.00
	1,025.00
June 30, 1900, amount expended during fiscal year	305.25
July 1, 1900, balance unexpended	719.75
July 1, 1900, outstanding liabilities	700.00
July 1, 1900, balance available	19.75

3 M.

DEFENSES OF THE COAST OF GEORGIA AND OF CUMBERLAND SOUND, GEORGIA AND FLORIDA.

Officer in charge of defenses of coast of Georgia, Capt. Cassius E. Gillette, Corps of Engineers; assistant, Lieut. Lytle Brown, Corps of Engineers, until August 10, 1899. Officers in charge of defenses of Cumberland Sound, Capt. Charles H. McKinstry, Corps of Engineers, until May 24, 1900, and Capt. Cassius E. Gillette, Corps of Engineers, after that date; assistant, Lieut. Edward M. Markham, Corps of Engineers, until May 24, 1900. Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Emplacements for eight 12-inch mortars.—Work on this battery was begun in December, 1898. For a description of the work, plant used, and summary of operations prior to July 1, 1899, see Appendix 4 L, pages 871 to 875, Annual Report of the Chief of Engineers for 1899.

The battery was completed during the month of March, 1900, and on April 9, 1900, was transferred to the artillery commander.

The following work was done during the fiscal year: 5,810 cubic yards of concrete; 452 cubic yards of random rock; 26,012 cubic yards of sand fill; 2,084 cubic yards of sand excavation; 1,595 square yards of damp course; 5,471 square yards of Bermuda grass; 4,116 square yards of marsh sod, 255 cubic yards of black earth, and 6 carloads muck, for holding sand on parapet and protecting blowing sand areas in vicinity of battery; 445 linear feet of sewer pipe, and 35 linear feet of pavement.

Base rings for the eight mortars were placed in position, leveled and grouted.

Racer circles were unloaded from cars with derrick and placed conveniently for the artillery.

The total cost of this battery was $125,442.

At the close of the fiscal year the eight mortars had been mounted by the artillery.

Engineering methods: This emplacement was built entirely of Portland-cement mortar, with the result that the magazines have thus far apparently been absolutely dry. Two of the rooms during the past winter have been filled with cement in barrels, and it has kept perfectly. In the specifications for this cement the following paragraph was inserted:

> *Tensile strength.*—Bids will be made on the basis of the cement developing a tensile strength of 320 pounds per square inch under the tests described below. Cement that exceeds this figure will be paid for at an increased price; cement that falls below it, but not below 200 pounds, will be accepted and paid for at a reduced rate. When the cement is received each barrel will be numbered and a sample taken from one barrel of each group of ten. This sampling will be done by the engineer officer or his agent. Each sample will be given a number corresponding to the group of 10.
>
> Three parts, by weight, of standard sand will be mixed with one part of cement, and a quantity of water equal in weight to between 7 and 8 per cent of the mixture of cement and sand. After mixing these thoroughly the mortar will be made into briquettes (of the pattern recommended by the committee of the American Society of Civil Engineers in 1885) on a Boehme machine, striking each briquette 120 blows (of a hammer weighing 2 kilograms, falling one-fourth of a meter). Four briquettes will be made of each sample. The briquettes will be kept twenty-four hours in moist air and twenty-seven days in fresh water, kept free from alkali by frequent renewals, and maintained at a temperature between 60 and 70 degrees F., and then broken on a reliable testing machine, the weight being run on at a rate of about 100 pounds in twelve seconds.
>
> The price of each cargo will be determined by the average of all specimens taken from the cargo, except those that fall below 200 pounds, which will be rejected or not paid for at all, except upon a subsequent test of each barrel of the rejected groups of 10. If the necessities of the work require any barrels of less than 200 pounds strength to be used, such barrels will be counted in computing the average strength. If the average of the test is 320 pounds, the price bid will be paid. For every 10 pounds increase over 320 pounds, 5 cents per barrel will be added to the price bid, and for every 10 pounds below 320 pounds 10 cents per barrel will be subtracted from it.
>
> A representative of the contractor may be present during the tests.
>
> NOTE.—For the information of bidders unfamiliar with the above hammer machine it may be said that under the above test a cargo of Atlas cement, 98 briquettes, gave an average of 324 pounds, the temperature of the water averaging 70 degrees F. A sample of Germania gave 310 pounds at 56 degrees F., and a cargo of Hemmoor (100 briquettes at 81 degrees F.) gave 326 pounds, and a cargo of Lehigh under these conditions gave 354.5 pounds.

Theoretically, this provision gives an opportunity for wider competition among bidders. Naturally, with the specifications usually used, only those manufacturers will bid whose cement is somewhere near the quality called for. The above specification should admit others on an equal basis, and it makes quality as well as price a determining element in the competition.

Practically, in this case only two bidders competed, and they apparently both bid about the market price of their cement. Difficulties, too, were met with in making equitable tests. It was found that so small an element as the wear of the molds in hammering in the mortar produced a decided variation in the breaking strength, and the briquettes varied very greatly if the quantity placed in the mold varied much, the surplus in each case being scraped off.

The terms of the contract, and the fact that the bidders quoted about their market price, together with the quality of the cement, made the price per barrel quite high, viz, $2.47. One satisfactory result, however, of the provision is the fact that it secured a cement of remarkable excellence.

Money statement.

July 1, 1899, balance unexpended	$57,052.03
June 30, 1900, amount allotted during fiscal year	17,310.00
	74,362.03
July 1, 1900, amount expended during fiscal year	73,837.29
July 1, 1900, balance unexpended	524.74
July 1, 1900, outstanding liabilities	524.74

Abstract of bids opened by Capt. Cassius E. Gillette, Corps of Engineers, United States Army, on July 22, 1899, for Portland cement for gun and mortar batteries, emplacements for eight 12-inch mortars.

No.	Name and address of bidder.	Cement (5,000 barrels), price per barrel.	Amount.	Remarks.
1	Lehigh Portland Cement Co., Allentown, Pa.	$2.30	$11,500	
2	Southeastern Lime and Cement Co., Charleston, S. C.	2.47	12,350	Informal.

It is recommended that the bid of the Lehigh Portland Cement Company be accepted, they being the lowest responsible bidders for the best and most suitable article.

Amount available, $11,500.

The following contract was in force during the fiscal year:

With Lehigh Portland Cement Company, of Allentown, Pa., for furnishing Portland cement (5,000 barrels). Date of contract, July 29, 1899; approved September 12, 1899; delivery to commence on or before the 15th day of September, 1899.

Emplacements for two 4.7-inch rapid-fire guns.—Work of grading and excavating for foundations was begun on March 28, 1899, and at the close of March, 1900, the battery was completed and the guns mounted. The battery was reported ready for transfer to the artillery, but had not been so transferred at the close of the fiscal year.

The total amount allotted for this work was $16,385.

For a summary of operations prior to July 1, 1899, see Report of the Chief of Engineers for 1899, page 875.

The following work was done during the fiscal year: Seven hundred and fourteen cubic yards of concrete placed; 957 cubic yards of sand fill made and sodded; 320 cubic yards of sand excavated; 86¼ square yards of asphalt damp course placed; hand rails, doors, walks, etc., completed.

An artesian well was sunk to a depth of 127 feet, but was finally abandoned, the work proving a failure.

Amount expended to June 30, 1899	$2,564.86

Money statement.

July 1, 1899, balance unexpended	$12,235.14
June 30, 1900, amount allotted during fiscal year	1,585.00
	13,820.14
June 30, 1900, amount expended during fiscal year	13,809.20
July 1, 1900, balance unexpended	10.94
July 1, 1900, outstanding liabilities	10.94

Emplacements for two 15-pounder rapid-fire guns at site No. 1.—On November 3, 1898, an allotment of $100 was made for the preparation of plans for this battery. No work was done during the fiscal year ending June 30, 1899, as the best site for the battery was occupied by the trolley tower tracks used in construction of the mortar battery. Subsequent allotments aggregating $8,430 were made for the work.

Work was begun October 14, 1899, and at the close of March, 1900, the battery was completed with the exception of setting fixed ironwork for the guns, which has not yet arrived.

During the fiscal year the following work was done: Eight hundred and forty-one cubic yards of concrete placed; 5,686 cubic yards of sand fill made; 1,305 cubic yards of sand excavated; parapet covered with 1,651 square yards of sodding, and sand areas protected with compost, Bermuda grass cuttings, and seed oats; hand rails, doors, walks, etc., were completed; bridges built and painted; a small concrete wall built inside the toe of the slope to insure against undermining by storm tides, and 59 square yards asphalt and 12 barrels pitch used for waterproofing purposes.

Amount expended to June 30, 1899	$100.00

Money statement.

June 30, 1899, amount allotted during fiscal year	$9,430.00
July 1, 1900, amount expended during fiscal year	9,428.44
July 1, 1900, balance unexpended	1.56
July 1, 1900, outstanding liabilities	1.56

Preservation and repair of fortifications.—For a summary of operations prior to July 1, 1899, see Annual Report of the Chief of Engineers for 1899, page 879.

There was allotted during the fiscal year $7,645 for work of preservation and repair.

During the fiscal year the following work was done:

Twelve-inch emplacements: An artesian well was sunk to a depth of 155 feet in rear of left 12-inch emplacement, and pipes and fittings attached for furnishing continuous discharge into catch-basin or for pump and hose attachment. Trolley wheels at left emplacement were changed to smaller size. Some of the working parts of the equipment were adjusted; guide rods were added to powder hoists to replace guide strips which did not work smoothly; drains were cut in gun platforms; water tables were added to doors of shot lifts and insulation leaks stopped; surface cracks were poured full of oil and all exposed surfaces painted with two coats of waterproofing; trolley beams and outside ironwork were painted, and bolts put on doors; ceiling beams were also painted; a large quantity of sand which had drifted upon the superior slope of the left 12-inch emplacement was removed and four carloads of brush placed over this parapet to help hold it; sand was removed from the rear of the left 12-inch emplacement.

Eight-inch emplacements: Surface cracks and planes of weakness were filled with linseed oil and all exposed surfaces painted with alum-lye waterproofing compound. Trolley beams and outside ironwork were painted. Ceiling beams were painted. Repairs made to ammunition hoists and work of installing safety device for these hoists begun. Readjustment of base ring and racer path of gun No. 3. Part of the cement under this gun was found to be much softened, apparently by oil soaking into it, and it was removed and replaced with fresh concrete. Outer doors were refitted. A block on a crane was repaired. A pump was set up at the well and connections made to pipe on parapet. Gun pits and drain pipes were cleaned of sand. Holes were drilled in drain covers in ammunition passages. Insulation leaks were chipped out and refilled with mortar. The parapet surfaces were painted with alum-lye compound and all cracks filled with linseed oil.

Six-inch battery: The steps were beveled and rough surfaces smoothed. Work on well in rear of this and the 4.7-inch battery was begun, but had to be abandoned. Ceiling beams were painted. Sand, which had drifted in rear of battery, was partly removed.

Four and seven-tenths-inch battery: Ceiling beams were painted.

Covering blowing sand areas: The methods advised by the Department of Agriculture the previous year not having proved successful, owing to an almost complete lack of nourishment in the sand, the plan of covering the entire area with stable manure and with seed oats and chopped-up Bermuda grass roots was tried with complete success. The manure alone controls the sand, and gives a basis for vegetable growth of any kind desired.

Miscellaneous: The searchlight outfit was carefully overhauled in February and again in April, as was also the electrical apparatus for torpedo casemate. These were stored during April in one of the electrical rooms of the mortar battery, where they will be free from rust, dust, etc., and more accessible for overhauling. Two reels of lead-covered wire and one small oil engine for torpedo casemate were received.

Armament: No change in the armament took place during the fiscal year, except that eight carriages and mortars were received and mounted at the mortar battery.

Money statement.

July 1, 1899, balance unexpended	$1,127.71
June 30, 1900, amount allotted during fiscal year	7,545.00
	8,672.71
June 30, 1900, amount expended during fiscal year	5,720.81
July 1, 1900, balance unexpended	2,951.90
July 1, 1900, outstanding liabilities	366.27
July 1, 1900, balance available	2,585.63

Emplacements for two 15-pounder rapid-fire guns at site No. 2.—Work was begun June 1, 1899, and at the close of March, 1900, the battery was completed, with the exception of setting the fixed ironwork for the guns, which has not yet arrived. For a summary of operations prior to July 1, 1899, see Report of the Chief of Engineers for 1899, page 880.

Amount expended to June 30, 1899	$1,921.99

Money statement.

July 1, 1899, balance unexpended	$10,878.01
June 30, 1900, amount expended during fiscal year	10,795.54
July 1, 1900, balance unexpended	82.47
July 1, 1900, outstanding liabilities	72.38
July 1, 1900, balance available	10.09

Preservation and repair of fortifications; Site No. 2.—Under an allotment of $700, made June 9, 1899, work was begun in July, 1899, cleaning out ditch, etc. This work was completed in August, 1899. A ditch was dug one-half mile long, 4 feet deep, 10 feet wide at bottom, and 15 feet at top from the fort to the south channel, for the purpose of admitting salt water freely to the old moat. A dike alongside, 2,000 feet long, 15 feet wide, and 3 feet high, was thrown up. Part of the moat was cleaned out and a lot of rubbish hauled away. Two hundred dollars of this allotment was transferred for preservation and repair of another site by authority of Chief of Engineers, March 9, 1900.

The torpedo material stored in the casemates at this place were overhauled and given the prescribed treatment. The electrical apparatus pertaining to the torpedo outfit of this place was also overhauled and put in good condition.

The rain-discharge pipes on the ordnance sergeant's quarters were connected with the cable tank for the purpose of supplying the tank with rain water.

The woodwork of the torpedo storeroom was whitewashed.

An allotment of $75 was made January 17, 1900, for cleaning torpedo material and making connections for supplying rain water to cable tank.

Condition June 30, 1900: The wharf is in good condition and also the road to the fort. The moat is filled up. The sanitary condition is fairly good. The ordnance sergeant occupies quarters built on the terreplein and employees of the Light-House Department live in the casemates. There are two artesian wells on the island, giving a good supply of water.

Armament: The torpedo casemate and the emplacements for 15-pounder rapid-fire guns are in good condition. The 15-pounder guns and the fixed ironwork for same have not yet arrived. All the old ordnance at this place has been condemned and will shortly be sold.

Money statement.

July 1, 1899, balance unexpended	$750.41
June 30, 1900, amount allotted during fiscal year	75.00
	825.41
June 30, 1900, amount expended during fiscal year	795.57
July 1, 1900, balance unexpended	29.84
July 1, 1900, outstanding liabilities	8.26
July 1, 1900, balance available	21.58

Preservation and repair of fortifications, Fort Clinch, Fla.—No funds were allotted for this work during the fiscal year. At the beginning of the fiscal year there was available $1,675. The balance on hand at close of fiscal year was $1,179.96.

No work was done during the fiscal year except that five reels of cable were shipped to Tampa, Fla., for storage.

Condition June 30, 1900: There is no standing water in or about the fort. The artesian well gives a plentiful supply of good water. The roof of the hospital building has a small leak during heavy storms where the roof joins the gable ends. It is not of great importance. All other buildings are in good condition. The ordnance sergeant occupies quarters outside the fort.

Armament: No change in armament during the fiscal year. All the old ordnance at this place has been condemned and will shortly be sold.

This work was transferred to me May 24, 1900, by Capt. C. H. McKinstry, Corps of Engineers, United States Army.

Money statement.

July 1, 1899, balance unexpended	$1,181.60
June 30, 1900, amount expended during fiscal year	1.28
July 1, 1900, balance unexpended	1,180.32
July 1, 1900, outstanding liabilities	.36
July 1, 1900, balance available	1,179.96

3 N.

DEFENSES OF EAST COAST OF FLORIDA AND OF KEY WEST, FLORIDA.

Officers in charge, Capt. Charles H. McKinstry, Corps of Engineers, until May 24, 1900, from which date Capt. Thomas H. Rees, Corps of Engineers, was in temporary charge; assistant, Lieut. Edward H. Markham, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

DEFENSES OF EAST COAST OF FLORIDA.

Preservation and repair, Fort Marion, Fla.—For a brief historical sketch of this work, which was built during the Spanish possession of Florida and finished in 1756, attention is invited to the annual report of the officer in charge for 1889. It is not available for defense, but is worthy of preservation as an object of historical interest.

At the beginning of the fiscal year a balance remained of former allotment for preservation and repair. A portion of this amount was expended in cutting down and removing shrubbery and repairing masonry work of the "City Gates."

Money statement.

July 1, 1899, balance unexpended	$175.85
June 30, 1900, amount expended during fiscal year	46.85
July 1, 1900, balance unexpended	129.00

Preservation and repair of fortifications, St. Johns River, Florida.—On July 1, 1899, there was a balance available of former allotments of $1,478.50, for pay of watchman in charge of the public property and for care and preservation of torpedo property. On July 27, 1899, $600 was allotted for dismounting and packing ordnance material; of this amount $117.06 was returned to the Treasury unexpended.

A watchman was employed the entire year. The torpedo material was overhauled, cleaned, and stored away, after the application of preservatives, in July and August, 1899, and in April and May, 1900. Two inspections of this material were made during the year. All of the guns were dismounted, and, together with all other ordnance material, were packed up and shipped to Augusta Arsenal and elsewhere in October, 1899.

On June 11, 1900, $1,100 was allotted for pay of watchman and care of engineer property and torpedo material during the fiscal year ending June 30, 1901.

Money statement.

July 1, 1899, balance unexpended		$1,538.50
July 27, 1899, amount allotted		600.00
June 11, 1900, amount allotted		1,100.00
		3,238.50
November 13, 1899, restored to appropriation	$117.06	
June 30, 1900, amount expended during fiscal year	1,893.29	
		2,010.35
July 1, 1900, balance unexpended		1,228.15
July 1, 1900, outstanding liabilities		60.00
July 1, 1900, balance available		1,168.15

Sites for fortifications.—An allotment of $250 was made July 1, 1899, for surveying boundaries of the site upon which reports had been submitted January 9 and June 24, 1899. On November 6, 1899, $1,500 was allotted for making a topographical survey of this land for use in preparing a project for the defenses.

A survey of the boundary lines was made in September and October, 1899. The topographic survey was made in November and December. A report giving description of the site recommended to be acquired was submitted January 4, 1900. No funds being available, no further steps were taken toward the acquisition of this site.

Money statement.

July 1, 1899, amount available		$250.00
November 6, 1899, amount allotted		1,500.00
		1,750.00
June 30, 1900, amount expended during fiscal year	$1,749.93	
January 19, 1900, amount restored to appropriation	.07	
		1,750.00

DEFENSES OF KEY WEST, FLA.

Emplacements for four 10-inch and two 8-inch guns on disappearing carriages and for eight 12-inch mortars.—These emplacements are being built by contract under the provisions of the act of June 6, 1896. Contract was entered into with the Venable Construction Company, of Atlanta, Ga., on March 4, 1897. The work was to have been completed by January 1, 1898, but a number of extensions of the time of completion have been granted by the Secretary of War. For details as to advertisements, award of contract, extensions of time for completing the contract prior to June 30, 1899, cost of work, plant, and methods of doing the work, etc., see Reports of the Chief of Engineers for 1897, page 704, 1898, page 721, and 1899, page 890.

On July 24, 1899, the contract was extended eight months, and on March 22, 1900, it was extended four months, by the Secretary of War.

Concrete work at the gun battery is completed, except about 14 cubic yards required to build steps from roadway to top of sand embankment at rear of battery. All ironwork is completed. There remains to be placed in the parapet about 3,987 cubic yards of sand fill and 3,210 cubic yards loam fill. About 9,630 square yards of parapet remain to be planted with Bermuda grass.

At the mortar battery about 700 cubic yards of concrete remain to be placed in the inclined retaining walls about the mortar pits, in the observation stations, and in the steps leading thereto. About 40,733 cubic yards of sand fill and about 3,473 cubic yards of loam fill remain to be placed. There are about 10,417 square yards of parapet to be planted with Burmuda grass.

At the beginning of the year work by the contractor on the gun battery was in progress and continued until September 2, 1899, when operations were suspended on account of yellow fever. The quarantine was raised on November 24, 1899, and work was resumed in December, but other than the putting in of a small amount of ironwork in December, no actual construction work was accomplished until in April, 1900. The contractors' plant and force that had been engaged in dredging the sand for fill had become disorganized during the suspension of work, and from December until April their operations were confined to preparations for resuming dredging and filling.

The items of work accepted and paid for during the year ending June 30, 1900, are as follows:

Gun battery.

Sand fill	cubic yards..	25,383
Stairs, iron	pounds..	5,187
Iron-pipe railing	feet..	87
Iron-pipe railing posts	do....	36

No work was done on the mortar battery. The above items, in addition to those given on page 891, Report of the Chief of Engineers for 1899, represent the total work done by the contractor to June 30, 1900.

An electrical firing apparatus was installed in the mortar battery, and some repairs of leaks in the magazines of these batteries were made. This work was done by hired labor.

On March 28, 1900, $575 was allotted from appropriation for "Gun and Mortar Batteries" for the purchase and installation of 12 locking devices for the ammunition hoists in these emplacements. The locking devices were purchased under circular proposals and were installed by hired labor.

On June 11, 1900, an allotment of $1,800 was made for providing communicating galleries between the emplacements of this battery. Plans for an iron gallery were prepared and submitted for approval.

Money statements.

BATTERIES.

July 1, 1899, balance unexpended		$69,851.28
June 30, 1900, amount expended during fiscal year		13,273.17
July 1, 1900, balance unexpended		56,578.11
July 1, 1900, outstanding liabilities	$3,208.54	
July 1, 1900, covered by uncompleted contracts	50,125.48	
		53,334.02
July 1, 1900, balance available		3,244.09

LOCKING DEVICES.

March 28, 1900, amount allotted	$575.00
June 30, 1900, amount expended during fiscal year	4.90
July 1, 1900, balance unexpended	570.10
July 1, 1900, outstanding liabilities	536.46
July 1, 1900, balance available	33.64

GALLERY.

June 11, 1900, amount allotted	$1,800.00
July 1, 1900, balance unexpended	1,800.00

Emplacements for two 12-inch breech-loading rifles.—These emplacements were practically completed at the close of the last fiscal year. In July, 1899, the trolley beams were placed and doors hung, completing the work that had been provided for.

The battery was turned over to the care of the troops on February 3, 1900. The guns and carriages are on hand and are to be mounted by the troops. An electric-lighting plant is to be provided for this battery when funds become available.

The total amount allotted for these emplacements was $113,000, and the total amount expended to June 30, 1900, was $112,891.97.

Money statement.

July 1, 1899, balance unexpended	$11,593.90
June 30, 1900, amount expended during fiscal year	11,485.87
July 1, 1900, balance unexpended	108.03

Two 4.7-inch rapid-fire gun emplacements.—These emplacements had been completed during the previous fiscal year. They were cared for by the Engineer Department until February 3, 1900, when they were turned over to the troops. No funds were available for this work during the fiscal year other than the general funds for preservation and repair of fortifications, report of which is made under separate heading.

Four emplacements for 15-pounder rapid-fire guns.—Two of these emplacements had been completed at the close of the previous fiscal year as far as it was practicable to carry work in advance of receipt of gun mounts. No additional work was done on them during this fiscal year, as the gun mounts were not received.

Work on the other two emplacements was continued by hired labor until September 1, 1899. During July and August, 627 cubic yards of concrete were put in, making a total of 1,127 cubic yards placed. No further work can be done until the receipt of the gun mounts.

The total amount allotted for these emplacements was $22,750. The total amount expended to June 30, 1900, was $20,869.25.

Money statement.

July 1, 1899, balance unexpended	$6,883.63
December 2, 1899, amount allotted	750.00
	7,633.63
June 30, 1900, amount expended during fiscal year	5,752.88
July 1, 1900, balance unexpended	1,880.75

Two emplacements for 15-pounder rapid-fire guns.—Plans for two additional emplacements for 15-pounders and a project for their construction were approved and $13,000 allotted for the work. Their construction will begin at an early date.

Money statement.

June 22, 1900, amount allotted	$13,000.00
July 1, 1900, balance available	13,000.00

Installation of electric-light plant.—This work embraced the construction of two power stations and the installation of separate lighting plants in the battery of four 10-inch and two 8-inch disappearing guns and in the mortar battery.

At the end of the previous fiscal year the power stations had been completed, and both engines and storage batteries and the dynamo at the mortar battery had been installed. During this year the dynamo at the gun battery was installed, wiring at both batteries was finished, and lamps were placed, completing the plants, which were then turned over to the care of the troops on March 12, 1900.

The total amount allotted for these plants was $19,300.

Money statement.

July 1, 1899, balance unexpended	$7,938.73
November 29, 1899, amount allotted	800.00
	8,738.73
June 30, 1900, amount expended during fiscal year	8,686.42
July 1, 1900, balance unexpended	52.31
July 1, 1900, outstanding liabilities	38.37
July 1, 1900, balance available	13.94

Road covering for batteries.—The contract for the construction of the battery for four 10-inch and two 8-inch guns and the mortar battery requires the contractor to place sand filling for a roadway in rear of the gun battery, in rear of the mortar battery, and between the two batteries. The work contemplated under this heading is the placing of 6 inches of crushed brick and concrete, obtained from the pulling down of the old fort, on the sand fill placed by the contractors. A concrete curbing is also to be placed. During the year about 1,000 cubic yards of brick have been crushed, and 250 blocks of concrete curbing, each 4 feet long, have been made, the work being done by hired labor.

This road covering will be completed immediately after the necessary fill is made.

Money statement.

July 1, 1899, balance unexpended	$3,000.00
June 30, 1900, amount expended during fiscal year	1,573.62
July 1, 1900, balance available	1,426.38

Mining casemate and cable gallery; cable tank and casemates for storage of torpedo material.—The mining casemate and cable gallery was practically completed in December, 1897, only a small amount of sand fill and sodding remaining to be placed. A survey of the sand fill over the casemate was made this year, and as it was found to be of sufficient thickness, no further fill was made. The total cost has been $10,000.

The cable tank was completed during the previous fiscal year with the exception of the placing of the intake water pipe. This has since been placed. The total cost has been $4,800.

The work of fitting up casemates in the old masonry work for the storage of torpedo material was finished.

Money statements.

MINING CASEMATE.

July 1, 1899, balance unexpended	$38.43
June 30, 1900, amount expended during fiscal year	38.43

CABLE TANK.

July 1, 1899, balance unexpended	$171.20
June 30, 1900, amount expended during fiscal year	171.20

CASEMATES.

July 1, 1899, balance unexpended	$147.28
June 30, 1900, amount expended during fiscal year	147.28

Preservation and repair of fortifications.—Operations during the year were carried on with the balance of funds available at the beginning of the year, together with an allotment of $500 made November 9, 1899, and $105 made January 20, 1900.

The reservation was cleared of trash and débris, weeds were removed, office building, fort keeper's quarters, storehouses, etc., were kept in repair, and were painted and whitewashed where necessary; the ironwork (such as trolleys and tracks, ammunition hoists, cranes, railings, beams, etc.) at all the gun and mortar batteries was scraped and painted and preserved from rust; and the engines and dynamo of the electric-light plant were run at regular intervals until turned over to the care of troops. The entire fortification works, including guns and carriages, were cared for during the period from September to December, 1899, when the troops were quarantined in the barracks on account of the yellow fever epidemic at Key West.

All of the torpedo material was twice overhauled and inspected during the year. All articles requiring it were painted, oiled, or otherwise covered with preservatives and securely stored away.

On June 11, 1900, $2,500 was allotted for care of the works of fortification and the torpedo material during the fiscal year ending June 30, 1901.

Money statements.

FORT TAYLOR, FLA.

July 1, 1899, balance unexpended	$219.17
November 9, 1899, amount allotted	500.00
	719.17
June 30, 1900, amount expended during fiscal year	719.17

CARE AND PRESERVATION OF TORPEDO MATERIAL.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	955.74
July 1, 1900, balance unexpended	44.26
July 1, 1900, outstanding liabilities	44.26

KEY WEST, FLA.

July 1, 1899, balance unexpended	$2,660.00
January 20, 1900, amount allotted	105.00
June 11, 1900, amount allotted	2,500.00
	5,265.00
June 30, 1900, amount expended during fiscal year	2,763.74
July 1, 1900, balance unexpended	2,501.26
July 1, 1900, outstanding liabilities	98.50
July 1, 1900, balance available	2,402.76

Supplies for artillery.—On May 10, 1900, $100 was allotted from appropriation for "Preservation and Repair of Fortifications" for the purchase of supplies for the preservation and care of the electric-light plants at the gun and mortar batteries, upon a requisition of the commanding officer, Key West Barracks, duly approved by the Chief of Engineers. The supplies requested were procured and turned over to the troops.

Money statement.

May 10, 1900, amount allotted	$100.00
June 30, 1900, amount expended during fiscal year	65.75
July 1, 1900, balance unexpended	34.25

Supplies for coast defenses.—On June 7, 1900, $600 was allotted from the appropriation "Supplies for Coast Defenses" for the purchase of such supplies as might be called for by requisitions of the artillery, duly approved by the Chief of Engineers.

Money statement.

June 7, 1900, amount allotted	$600.00
July 1, 1900, balance unexpended	600.00

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DEFENSES OF TAMPA BAY, FLORIDA.

Officers in charge, Capt. Henry Jervey, Corps of Engineers, to January 18, 1900; Capt. Thomas H. Rees, Corps of Engineers, since January 18, 1900; assistant, Lieut. Frank C. Boggs, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Cable tank.—Under date of January 11, 1899, the sum of $5,725 was allotted from the appropriation "Torpedoes for Harbor Defense," act of May 7, 1898, for the construction of a cable tank.

The concrete tank and wooden superstructure were completed in March, 1899, with the exception of installing a traveling crane for handling the drums of cable. This crane has been furnished and installed under contract with the New Jersey Foundry and Machine Company. It has been found satisfactory in every respect, and handles the drums of cable with ease and dispatch. In addition, the leaky floor of the tank has been repaired, a siphon has been furnished for emptying the tank when necessary, and the building covering the tank has been painted.

Money statement.

July 1, 1899, balance unexpended	$1,017.18
June 30, 1900, expended during fiscal year	1,017.18

Emplacements for eight 12-inch mortars.—The approved project was to construct emplacements for eight 12-inch mortars on carriages, model of 1896, at an estimated cost of $150,000. This sum was allotted from the appropriation for "Gun and Mortar Batteries," act of May 7, 1898, on July 30, 1898. An additional allotment was made December 23, 1899, of $5,000 from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899. Total allotment, $155,000. The preparation of plans and estimates was ordered June 7, 1898; the same were submitted July 25, 1898, and approved, with certain modifications, July 30, 1898. Field work commenced in November, 1898, with the construction of a wharf, and in December the work of clearing the site of the battery for the foundations was started.

On June 30, 1899, the following work had been completed:

A dock 275 feet long had been built and buildings for quarters and storage purposes erected.

The site of the work had been cleared and all concrete forms for the north half of the battery built.

Shell for use in concrete masonry had been accumulated from a shell bank on the island and screened.

A traveling cable way had been installed for placing concrete and sand filling.

The north half of the battery was well advanced, all forms for same were in place, the I-beams were set, and concrete was deposited nearly to the level of the magazine roof.

All the gun beds were completed and anchor bolts set ready for base rings.

The amount of material in place was about as follows:

	Cubic yards.
Concrete No. 1	2,881
Concrete No. 2	381
Concrete No. 3	182
Foundation filling of sand and shell	1,317
Sand fill in front of battery	2,452

Two mortar carriages had been received at the dock and moved to the battery site.

The entire cost of the battery to June 30, 1899, was $72,197.47.

During the fiscal year ending June 30, 1900, the emplacements have been completed and eight carriages mounted. On May 8, 1900, the battery was turned over to the artillery command.

During the year the work of placing concrete and I-beams and raising sand fill has been executed by hired labor. The plant used is described in the report of Lieut. R. P. Johnston, Corps of Engineers, printed in report of the Chief of Engineers for 1899, page 906, to which reference is respectfully made. The work performed may be stated as follows:

	1900.	1899.	Total.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*
Excavation			2,599
Sand fill	64,960	2,452	67,412
Concrete	5,550	3,444	8,994
Random stone		389	389
Shell and sand in foundation	3,356	1,317	4,673

An electric-lighting plant has been installed as follows:

One 13-horsepower Hornsby-Akroyd oil engine under contract of November 27, 1899, with the McCay Engineering Company, of Baltimore, Md.

One 7.5-kilowatt generator under contract of May 29, 1899, with the Northern Engineering Company, of New York.

One switchboard and three panel boards have been furnished.

Ninety-seven lamps and the necessary wiring under contract of October 10, 1899, with the D'Olier Engineer Company, of Philadelphia, Pa.

All parts of the battery are well lighted by this system.

For handling ammunition a trolley system, consisting of overhead track and Yale & Towne block attached to trolley, has been furnished under contract of December 19, 1898, with the New Jersey Foundry and Machine Company, of New York.

For details of the work and distribution of expenses attention is respectfully invited to Lieutenant Boggs's very full report submitted herewith.

Money statement.

July 1, 1899, balance unexpended	$77, 802. 53
Allotted since	5, 651. 96
	83, 454. 49
June 30, 1900, expended during fiscal year	83, 454. 49

REPORT OF LIEUT. FRANK C. BOGGS, CORPS OF ENGINEERS.

MORTAR BATTERY.

This battery consists of eight 12-inch mortars and commands the main entrance to Tampa Bay.

The nearest business centers are Tampa and Port Tampa, at distances of 35 and 23 miles, respectively, communication being had by water. Until November, 1899, a tug was employed for transporting the men, provisions, etc., to the works, but after that date this was done by a boat chartered by the Quartermaster's Department. This boat makes daily trips, carrying mail, supplies, etc., for the garrison of artillery.

For a description of the plant used in erecting the battery, attention is invited to the report of Lieut. R. P. Johnston, Corps of Engineers, Report of Chief of Engineers for the year 1899, vol. 1, page 906. Due to the failure of the contractor for crushed rock to supply the material as required, systematic work could not be commenced until the 1st of June, 1899. From that time the work was carried on without intermission or delay.

The original plans for the battery required excavation for the foundation of almost 4 feet, but after the excavation had been made it was discovered that the water would rise in the mortar pits to a height of from 1 to 2 feet. It was therefore decided to raise the battery. In order to save the additional cost of concrete necessary to raise the battery, sand was used, it being thoroughly watered and tamped.

Since the completion of the work, the battery has shown a slight settlement, the maximum being about three-fourths of an inch. This is, I think, due partly to the sand fill above mentioned and partly to a course of shell which was placed as a foundation course for the concrete.

The concrete used in the battery consists of a mixture of crushed rock, shell, sand, and Portland cement. The sand and shell were gathered from natural deposits found on the key, the former being clean and sharp. The shell are small, with a corrugated surface, and form an excellent bond with the sand and stone. After completing the concrete work the entire battery was covered with a damp-proof course consisting of a mixture of Neuchatel asphalt, refined bitumen, and sand. These were mixed in the proportion of 100 pounds bitumen, 660 pounds asphalt, and 12 buckets of sand, the ingredients being placed over a hot fire and thoroughly incorporated. The above amount should cover a space of about 25 square yards to a depth of one-half inch. Before this course was laid the concrete was troweled to a smooth surface. The vertical walls and the asphalt course were treated with a coat of coal tar and rosin, and a vertical layer of stone was placed between the concrete walls and the sand fill.

The sand used for protecting the battery was gathered within a short distance of the work. The material was hauled from the pits by the locomotive to a position under the cable way, by which the skips were taken from the flats and dumped as required. This fill was done at an average cost of 10 cents per yard, including subsistence of employees, laying track, repairs, etc. After completing the fill a layer of rich loam was laid to a depth of about 1 foot, in which was sowed a mixture of Bermuda grass seed and oats, the latter being used to bind the earth until the grass could obtain a hold.

The electrical plant consists of a 7.5-kilowatt generator operated by a 13-horsepower Hornsby-Akroyd oil engine. From the switchboard, which is located in the dynamo room in the east section of the battery, lead wires run to panel boards located one in each section. From these boards the light circuits are run. All wires are laid in insulated conduits, the pipes being embedded in the concrete.

In setting the base rings for the mortar carriages, the following method was used: The bolts were set in the usual manner with a double templet. When ready for the base ring, four of the bolts on the diagonals of a square were threaded so that an additional nut could be screwed on each. This nut was screwed down to such a level that the top was on the final level for the bottom of the base ring. The base ring was then lowered into position, resting on the four nuts mentioned above. By raising or lowering the nuts the ring was set with very little trouble.

Eight mortar carriages have been received and erected.

Following is a tabulated statement of quantities and cost.

Total work on battery.

	Cubic yards.
Excavation	2,599
Sand fill	67,412
Concrete	8,994
Random stone	389
Foundation of shell and sand	4,673

Cost of material.

Cement ($0.59 added for storing), per barrel	$2.46
Crushed stone ($0.29 added for storing), per cubic yard	2.95
Random stone ($0.38 added for storing), per cubic yard	3.04
Shell, screening and storing, per cubic yard	.45
Sand, screening and storing, per cubic yard	.12
Lumber for forms, rough, per M	10.25
Lumber for forms, dressed, per M	12.75

Cost of concrete in place.

Cement (1 barrel)	$2.46
Shell (8½ cubic feet)	.142
Sand (14 cubic feet)	.062
Crushed stone (24 cubic feet)	2.622
Mixing and placing	.693
	5.979

The above batch tamped in place to 30 cubic feet.

Cost per yard of concrete	$5.381
Form work per yard	.370
Total cost per yard	5.751

Itemized statement of material and labor.

	Material	Labor.	Total
Purchase of plant	$11,116.69		$11,116.69
Hire of plant	775.00		775.00
Erection of quarters	2,664.72	$3,336.74	6,001.46
Erection of dock	2,499.00	918.40	3,417.40
Erection of track, trestle, and bins	4,216.18	4,220.60	8,436.78
Erection of and repair to plant	2,021.20	3,574.93	5,596.13
Clearing site of battery, excavating foundation, and tamping sand and shell in same		1,800.85	1,800.85
Unloading and storing material		9,657.07	9,657.07
Transportation, hire of tugs, lighters, etc	7,880.91		7,880.91
Hire of teams	1,529.44		1,529.44
Crushed and random stone	20,412.49		20,412.49
Cement	25,904.40		25,904.40
Shell	193.57		193.57
Forms for concrete	1,844.29	3,483.79	5,328.08
Drainage and ventilation	623.76	302.54	926.30
Mixing and placing concrete		6,235.85	6,235.85
Damp-proof course	1,047.00	369.14	1,416.14
Structural ironwork	3,633.67	192.05	3,825.72
Speaking tubes	172.74	30.00	202.74
Trolley system	1,699.82		1,699.82
Electric-light and power plant	2,931.61	184.19	3,115.80
Operating expenses (fuel, oil, etc.)	1,795.52		1,795.52
Subsistence	4,768.92	2,184.71	6,953.63
Sand fill in parapet		6,304.25	6,304.25
Loam covering and grass seed	12.22	333.61	345.83
Doors, windows, etc	594.90	225.99	820.89
Cleaning and mounting ordnance		1,130.56	1,130.56
Taking down and storing plant, and care of battery		616.67	616.67
Office expenses	370.74		370.74
Telegraph, telephone, and express	92.12		92.12
Additional pay on account of holidays		300.00	300.00
Printing, advertising, etc	120.05		120.05
Mileage and travel expenses	203.76		203.76
Superintendence and engineering		10,432.81	10,432.81
Total	99,124.72	55,834.75	154,959.47

Two emplacements for 8-inch guns on disappearing carriages.—The approved project was to construct two emplacements for 8-inch B. L. rifles on disappearing carriages, L. F. model of 1896, at an estimated cost of $97,500. This amount was allotted October 4, 1898, from appropriation for "Gun and Mortar Batteries," act of July 7, 1898 Additional allotments were made as follows: $1,000 on July 5, 1899, from act of March 3, 1899; $10,000 on August 10, 1899, from act of July 7, 1898; $10,000 on November 10, 1899, from act of March 3, 1899; total allotment, $118,500. The preparation of plans and estimates was ordered July 11, 1898, and the same were submitted September 29, 1898, and approved October 3, 1898. Actual work in the field began in October, 1898, with the construction of quarters and a railroad track from wharf to battery site and an extension of the wharf.

On June 30, 1899, the following work had been completed:

A dock had been built and 1,350 feet of railroad track laid from the dock to the battery site.

Buildings for quarters and storage purposes had been erected.

The site of the battery had been cleared and forms erected for the north emplacement.

Shell for use in concrete masonry had been transported by lighter from the neighboring key, screened, and delivered into material bins. A large quantity of unscreened shell had also been used in foundation fills and in ballasting railroad tracks.

Concrete work had been confined to the north emplacement, as the single revolving crane derrick constituting the depositing plant had a limited radius of delivery. It is in this respect inferior to the traveling cableway.

About 1,518 cubic yards of concrete had been placed in the battery.

One 8-inch disappearing carriage was received in February, 1899.

During the fiscal year ending June 30, 1900, the emplacements have been completed, and on May 8, 1900, the battery was turned over to the artillery command.

During the year the placing of concrete and I-beams and raising of sand fill has been carried on by hired labor. The plant used is described in the report of Lieut. R. P. Johnston, Corps of Engineers, printed in Report of Chief of Engineers for 1899, page 909, to which reference is respectfully made.

The 8-inch disappearing carriage, model of 1896, received during the previous year, has been mounted, and a second carriage was received and turned over to the artillery command for mounting.

The following plant for lighting the battery and handling ammunition has been installed:

One 17-horsepower Hornsby-Akroyd oil engine under contract of November 27, 1899, with the McCay Engineering Company, of Baltimore, Md.

One 10-kilowatt generator under contract of November 29, 1899, with the Northern Engineering Company, of New York, N. Y.

Two electrical hoists for ammunition service under contract of December 19, 1898, with the New Jersey Foundry and Machine Company of New York.

Four cranes under same contract.

Trolley system complete under same contract.

Necessary lamps and wiring under contract of October 10, 1899, with the D'Olier Engineering Company, of Philadelphia, Pa.

Switchboard and panel boards have been purchased and installed.

For details of the work and distribution of expenses, attention is respectfully invited to the report of Lieutenant Boggs, who was in immediate charge of the work and whose report is submitted herewith.

Money statement.

July 1, 1899, balance unexpended	$44, 154.01
Allotted since	21, 449.53
	65, 603.54
June 30, 1900, expended during fiscal year	65, 603.54

REPORT OF LIEUT. FRANK C. BOGGS, CORPS OF ENGINEERS.

8-INCH BATTERY.

This battery consists of emplacements for two 8-inch rifles on disappearing carriages.

The means of communication are the same as described in the report for the mortar battery.

For a description of the plant used, attention is invited to the report of Lieut. R. P. Johnston, Corps of Engineers, Report of Chief of Engineers for the year 1899, Part I, page 909.

The general features relative to the ingredients for concrete and damp-proof course are similar to corresponding ones in the mortar battery, and a repetition of their description is unnecessary.

The plant used in erection was in no way equal to the plant at the mortar battery, a consequent increase in the cost of the various items being the result. The derrick on the dock for handling material was not large enough to reach the hatches of the schooners carrying cement and stone, and recourse was had to a gaff swung from the mast of the schooner. This, however, was not satisfactory. The crane derrick used at the battery was limited to an area bounded by the circumference of a circle of 55 feet radius—the length of the boom. This limitation necessitated that a great deal of the material in the battery be moved in barrows, thereby adding to the expense.

In placing the sand in the parapet fill the material was loaded in skips placed on flat cars, which were run within reach of the derrick. Within the radius of 55 feet the sand was dumped directly in place; beyond this it was dumped from the skips into side-dump cars, which were run on a track placed on top of the fill.

The electrical plant consists of a 10-kilowatt generator operated by a 17-horsepower Hornsby-Akroyd oil engine. From the switchboard, which is located in the dynamo room, lead wires run to panel boards located in each section of the battery and to the ammunition hoists. The light circuits are run from these boards. All wires are laid in insulated conduits which are embedded in the concrete.

The method of placing the base rings as recommended by Supt. R. F. Ensey and adopted on the work was slightly different from that used at the mortar battery. Before the concrete for the gun blocks was placed four lengths of 1½-inch pipe were driven into the foundation in such a manner that the base ring could be lowered on them in its final position. The concrete for the gun blocks was then placed to the level of the bottom of the foundation bolts for the base ring, the lengths of pipe cut off, threaded, and capped so that the level of the cap would be the final level of the bottom of the base ring in position, and the base ring lowered into position. The bolts were suspended directly from the ring and the latter accurately set by raising and lowering the caps. By this method the use of the templet was done away with, the ring forming its own templet for the bolts.

One carriage has been received and erected. The second was received and turned over to the artillery battery for mounting.

Following is a tabulated statement of quantities and cost:

Total work on battery.

	Cubic yards.
Excavation	930
Sand fill	14,189
Concrete	6,654
Random stone	455
Foundation of shell	227

Cost of material.

Cement ($0.07 added for storing), per barrel	$2.532
Crushed stone ($0.387 added for storing), per cubic yard	3.047
Random stone ($0.566 added for storing), per cubic yard	3.226
Shell, screening and storing, per cubic yard	.481
Sand, screening and storing, per cubic yard	.25
Lumber for forms, rough, per thousand	10.25
Lumber for forms, dressed, per thousand	12.75

Cost of concrete in place.

Cement (one barrel)	$2.532
Shell (8½ cubic feet)	.151
Sand (14 cubic feet)	.130
Crushed stone (24 cubic feet)	2.71
Mixing and placing	.761
	6.284
The above batch tamped in place to 30 cubic feet.	
Cost per cubic yard	5.655
Form work per yard	.22
Total cost per yard	5.875

Itemized statement of material and labor.

	Material.	Labor.	Total.
Purchase of plant	$5,555.91		$5,555.91
Hire of plant	350.00		350.00
Erection of quarters	1,588.74	$3,884.62	5,473.36
Erection of dock	1,100.45	934.54	2,034.99
Erection—track, trestle, and bins	2,475.06	4,229.39	6,704.45
Erection of and repairs to plant	1,147.17	6,171.25	7,318.42
Clearing site of battery, excavating foundation, and tamping shell in same		1,763.41	1,763.41
Unloading and storing material		10,482.48	10,482.48
Transportation—hire of tugs, lighters, etc	4,790.16		4,790.16
Hire of teams	1,594.31		1,594.31
Crushed and random stone	14,466.43		14,466.43
Cement	17,943.65		17,943.65
Shell	91.75		91.75
Forms for concrete	801.31	1,596.34	2,397.65
Drainage and ventilation	178.71	32.52	211.23
Mixing and placing concrete		5,508.51	5,508.51
Damp-proof course	368.91	108.70	477.61
Structural iron work	1,122.17	115.57	1,237.74
Speaking tubes	120.98	23.78	144.76
Ammunition hoists and trolley system	3,393.42		3,393.42
Operating expenses, fuel, oil, etc	1,215.58		1,215.58
Subsistence	4,097.62	2,315.68	6,413.30
Electric-light and power plant	2,929.99	618.66	3,548.65
Sand fill in parapet		1,800.24	1,800.24
Loam covering and grass seed	8.69	245.43	254.12
Doors, windows, etc	781.21	294.12	1,025.33
Cleaning and mounting ordnance		509.73	509.73
Taking down and storing plant and care of battery		931.57	931.57
Office expenses	597.13		597.13
Telegraph, telephone, and express	993.02		993.02
Additional pay on account of holidays		286.44	286.44
Printing, advertising, etc	123.56		123.56
Mileage and travel expenses	130.48		130.48
Superintendence and engineering expenses		9,578.32	9,578.32
Total	67,016.36	51,431.30	118,447.66

Preservation and repair of fortifications.—The work accomplished under this appropriation during the fiscal year ending June 30, 1900, consisted of inspecting, cleaning, moving, and protecting the submarine-mine material, and some urgent repairs to the Government dock.

Inspections of torpedo material: Inspections were made in August, 1899, and May, 1900, and reports submitted as required by General Orders, No. 1, Office Corps of Engineers, 1898. The first inspection cost $30 and an allotment was made by the Chief of Engineers on July 21, 1899, to cover it. The second inspection cost $32.76 and was paid for with a balance in hand from an allotment for cleaning and protecting the mining material in this district.

Cleaning and protecting mining material: In accordance with an estimate submitted August 24, 1899, the Chief of Engineers allotted the sum of $227 for the above purpose during the period ending November 30, 1899. Circumstances prevented the completion of this work until March, 1900, at which date the mining material had been put in good condition and properly stored for safe keeping. The cost was $194.24, the balance of the allotment being applied by authority to the expense of the last semiannual inspection.

Moving cable drums: This work was performed in February, 1900, and pertained to 5 reels of cable transferred from the St. Augustine district for storage in the cable tank. The expenses were defrayed by an allottment of $25, made by the Chief of Engineers December 29, 1899. The cost of the work was $7.95. The balance, $17.05, has been returned to the Treasury.

Repairing dock: On November 21, 1899, an allotment of $945 was made by the Chief of Engineers for the purpose of repairing the engineer dock, in accordance with estimate submitted November 16, 1899. The work was performed in December and January at a total cost of $785. The balance, $160, has been returned to the Treasury.

Money statement.

June 30, 1900, amount allotted during fiscal year	$1,227.00
Amount expended during fiscal year	1,049.95
	177.05
Deposited to the credit of the Treasurer of the United States	177.05

Abstract of proposals for material for electric plant received in response to advertisement dated July 19, 1899, and opened August 8, 1899, by Capt. Henry Jervey, Corps of Engineers.

CLASS A.

No.	Name and address of bidder.	Oil engines, etc.		Total.
		One 17-horsepower.	One 13-horsepower.	
2	McCay Engineering Co., Baltimore, Md	....	....	$3,285.00
4	D'Olier Engineering Co., Philadelphia, Pa	$1,562.00	$1,357.00	*a*2,919.00
5	New Jersey Foundry and Machine Co., New York, N. Y	2,074.00	1,084.00	3,878.00

CLASS B.

No.	Name and address of bidder.	Generators.		Total.
		One kilowatt, 110 volts.	One 7.5 kilowatt, 110 volts.	
1	General Electric Co., Schenectady, N. Y	$450.00	$375.00	$825.00
2	McCay Engineering Co., Baltimore, Md	....	....	*a*535.00
4	D'Olier Engineering Co., Philadelphia, Pa	441.00	410.00	851.00
5	New Jersey Foundry and Machine Co., New York, N. Y	348.00	298.00	646.00

CLASS C.

No.	Name and address of bidder.	Ampère accumulators.		Total.
		One 35 A. A.	One 50 A. A.	
2	McCay Engineering Co., Baltimore, Md	....	....	$2,746.00
3	The Electric Storage Battery Co., Philadelphia, Pa	$1,453.90	$2,101.00	3,554.90
4	D'Olier Engineering Co., Philadelphia, Pa	1,526.00	2,206.00	3,732.00
5	New Jersey Foundry and Machine Co., New York, N. Y	1,082.00	1,243.00	*a*2,325.00

CLASS D.

No.	Name and address of bidder.	Wire.								Twin conductor. No. 14, 3,600 feet.	Total.
		B and S gauge.						Solid.			
		No. 0, 100 feet.	No. 1, 100 feet.	No. 2, 800 feet.	No. 4, 500 feet.	No. 6, 100 feet.	No. 8, 400 feet.	No. 10, 200 feet.	No. 12, 200 feet.		
1	General Electric Co., Schenectady, N. Y	$0.22 22.00	$0.165 16.50	$0.15 120.005	$0.105 2.50	$0.09 9.00	$0.065 91.00	$0.06 12.00	$0.0325 6.50	$0.115 414.00	$743.50
4	D'Olier Engineering Co., Philadelphia, Pa	.13 13.00	.11 11.00	.08 64.00	.06 30.00	.05 5.00	.03 42.00	.02 4.00	.015 3.00	.0165 59.40	*a*231.40
5	New Jersey Foundry and Machine Co., New York, N. Y	.2475 24.75	.2025 20.25	.1775 142.00	.115 57.50	.09 9.00	.06 84.00	.05 10.00	.04 8.00	.0675 243.00	598.50

a Recommended for acceptance.

Abstract of proposals for material for electric plant received in response to advertisement dated July 19, 1899, and opened August 8, 1899, by Capt. Henry Jervey, Corps of Engineers—Continued.

CLASS E.

No.	Name and address of bidder.	Lamps.			Total.
		160 lamps.	4 desk lamps.	4 portable lamps.	
1	General Electric Co., Schenectady, N. Y	$466.80	$26.00	$12.00	$504.80
2	McCay Engineering Co., Baltimore, Md	....	....	....	350.00
4	D'Olier Engineering Co., Philadelphia, Pa	212.00	16.00	10.00	*a* 238.00
5	New Jersey Foundry and Machine Co., New York, N. Y	380.00	15.00	4.00	399.00

a Recommended for acceptance.

REMARKS.—2. Also bid lump sum of $6,600 for Classes A, B, C, and E complete. No authority for H. K. McCay, president, to sign.
3. No authority filed for C. M. Woodward to sign..
4. No authority for Henry D'Olier, jr., treasurer, to sign bid.

GUN AND MORTAR BATTERIES.

Two emplacements for 8-inch guns and emplacements for eight 12-inch mortars.

Abstract of proposals for furnishing oil engines, dynamos, and storage batteries received in response to advertisement dated October 5, 1899, opened at Tampa, Fla., 11 a. m. October 25, 1899, by Capt. Henry Jervey, Corps of Engineers.

CLASS A.-OIL ENGINES.

No.	Name and address of bidder.	17 horse-power.	13 horse-power.	Total.	Type and make proposed.
4	August Meitz, New York, N. Y	$1,585.00	$1,335.00	$2,920.00	Meitz & Weiss kerosene engine.
5	New Jersey Foundry and Machine Co., New York, N. Y.	2,050.00	1,765.00	3,815.00	Hornsby-Akroyd type, made by De La Vergne Refrigerating Machine Co.
6	The De La Vergne Refrigerating Machine Co., New York, N. Y.	1,946.00	1,550.00	3,496.00	Do.
9	McCay Engineering Co., Baltimore, Md.	....	....	*a* 3,485.00	Hornsby-Akroyd.

CLASS B.-GENERATORS.

No.	Name and address of bidder.	10 kilo-watt.	7.5 kilo-watt.	Total.	Type and make proposed.
2	Westinghouse Electric and Manufacturing Co., Atlanta, Ga.	....	....	$595.00	
3	Northern Engineering Co., New York, N. Y.	$339.00	$310.00	*a* 649.00	Northern Electrical Manufacturing Co., Madison, Wis.
5	New Jersey Foundry and Machine Co., New York, N. Y.	391.00	296.00	687.00	Four pole ironclad, made by C. and C. Electric Co.
7	General Electric Co., Schenectady, N. Y.	600.00	570.00	1,170.00	Multipolar, belt driven, General Electric Co.
9	McCay Engineering Co., Baltimore, Md.	....	....	813.00	Crocker-Wheeler.

CLASS C.-ACCUMULATORS.

No.	Name and address of bidder.	85 ampere.	50 ampere.	Total.	Type and make proposed.
1	The Electric Storage Battery Co., Philadelphia, Pa.	$1,511.80	$2,415.98	$3,927.78	Chloride, types E 15 and F 11, Electric Storage Battery Companies.
5	New Jersey Foundry and Machine Co., New York, N. Y.	1,513.00	2,422.00	3,935.00	Same. (Size not stated.)
8	Western Electric Co., New York, N. Y.	1,530.00	2,460.00	3,990.00	Same. (E 15 and F 11.)
9	McCay Engineering Co., Baltimore, Md.	....	....	*a* 3,189.00	As specified.

a Recommended for acceptance.

INFORMALITIES, REMARKS, ETC., ON BIDS RECEIVED.

1. Title of officer signing not given; no authority for officer signing furnished.
2. Informal, does not use blank form of proposal; bids submitted by letter not in accordance with specifications.
3. No authority for president to sign.
4. No witness to Walter Junge's signature, one of the guarantors; guaranty incomplete; bid on Meitz & Weiss kerosene engines, has small oil tank on top of cylinder instead of in base of engine; not sufficiently developed for recommendation of acceptance.
5. Date of bid omitted on guaranty; additional field regulators on generators, $22 each.
6. No authority for general manager to sign; 50-cent revenue stamp omitted.
8. No authority for officer to sign proposal; no witnesses to signature of guarantor; guaranty otherwise incomplete; no adhesive seal; triplicate copy not furnished.
9. No authority for president to sign; total for Class C should be $3,189 in figures instead of $3,198; duplicate and triplicate copies are correct.

The amount available for payment under the proposed contract is $7,500.

3 P.

DEFENSES OF PENSACOLA, FLA.

Officer in charge, Capt. Clement A. F. Flagler, Corps of Engineers; assistant, Lieut. Lewis H. Rand, Corps of Engineers; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Battery for four 10-inch guns on disappearing carriages.—This battery was completed and transferred to the artillery arm of the service by authorities of the Secretary of War dated February 24 and June 19, 1898. Owing to the cramped condition of the electric-light plant and the prevalence of water in the dynamo room, a modification was approved involving the construction of two additional rooms, removing the sand covering, and improving the ventilation. An allotment was made for this purpose May 25, 1900, from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898.

At the close of the year most of the material for this work had been ordered and the cement received; the railroad track and locomotive were overhauled, and the west entrance wing wall partially removed.

Money statement.

July 1, 1899, balance unexpended	$0.32
Amount allotted during the fiscal year	2,300.00
	2,300.32
June 30, 1900, amount expended during the fiscal year	.32
July 1, 1900, balance unexpended	2,300.00
July 1, 1900, outstanding liabilities	502.72
July 1, 1900, balance available	1,797.28

Battery for eight 12-inch mortars.—This battery was completed and transferred to the artillery arm of the service by authority of the Secretary of War dated June 5, 1899. The balance available was utilized in repairing washed slopes. The eight mortars received in April, 1899, were mounted by the artillery during the year.

Money statement.

July 1, 1899, balance unexpended	$158.99
June 30, 1900, amount expended during the fiscal year	153.55
July 1, 1900, balance unexpended	5.44
July 1, 1900, outstanding liabilities	5.44

Battery for four 15-pounder rapid-fire guns.—Plans and estimates for this battery were approved by the Chief of Engineers February 14, 1899, and work was begun March 16, 1899, on clearing and raising the site of the battery.

On June 30, 1899, the concrete was all in place except a portion of platforms 1 and 2 and all of platforms 3 and 4. The sand filling to raise the site to a reference of (10.5) was also in place.

The concrete was mixed with the cubical mixer used for the 8-inch battery, and deposited from a traveling derrick moving in front of the battery parallel to the crest.

Since July 1, 1899, work was carried on until the battery was completed, August 24, with the exception of the doors, hand railings, electric lights and latrine fixtures, and the armament. The armament has not been received, but all of the above fixtures are on hand, stored, and will be installed with the armament.

The sand filling of the parapets was covered with swamp sod and sown with Bermuda grass (*Cynodon dactylon*), and has shown no signs of wash except where cut by the waves on left flank. (See "Preservation and Repair of Fortifications," this report.)

The magazine roofs were asphalted and the battery appears to be dry, except during actual rains, when the floors are wet, owing to the absence of doors. The magazine floors have a considerable fall to the rear, preventing the possibility of standing water.

The cements used were Beach's natural cement and Alsen brand Portland. The gravel was round, clean-pit gravel, obtained from Flomaton, Ala., by contract. The proportions used were 1 cement, 2 sand, and 5 gravel. The sand was taken from the reservation.

One thousand two hundred and forty-three cubic yards of concrete were laid, at a cost per cubic yard of $8.51, including materials, forms, labor, rations, and superintendence. The elaboration of form for so small a quantity of concrete is the cause of the large cost.

Five thousand six hundred and ninety-six cubic yards, in all, of sand filling were deposited in place, at a cost of 28 cents per cubic yard.

The wells in the platforms were made large enough to permit easy and accurate insertion and fixing of the well-linings for the pillar mountings. A circular segmental cylinder 8 inches deep must be cut from the parapet in front of the gun in emplacements 1, 2, and 3, but this will be done when armament is received.

This work was in local charge of Mr. J. E. Turtle, Assistant Engineer.

Money statement.

July 1, 1899, balance unexpended	$6,234.81
Amount allotted during the fiscal year	14.58
	6,249.39
June 30, 1900, amount expended during the fiscal year	6,227.71
July 1, 1900, balance unexpended	21.68
July 1, 1900, outstanding liabilities	13.88
July 1, 1900, balance available	7.80

Battery for two 12-inch guns on disappearing carriages.—This battery was completed and transferred to the artillery arm of the service by authority of the Secretary of War dated June 5, 1899. The carriages and guns for this battery, received in March and April, 1899, were mounted by the artillery during the year.

Money statement.

July 1, 1899, balance unexpended	$266.60
June 30, 1900, amount expended during the fiscal year	108.01
January 30, 1900, balance unexpended	158.59
February 10, 1900, deposited to credit of Treasurer United States	158.59

Battery for two 4.72-inch rapid-fire guns.—This battery was completed and transferred to the artillery arm of the service in October, 1898. The guns and carriages are all mounted.

Money statement.

July 1, 1899, balance unexpended	$14.64
July 24, 1899, deposited to credit of Treasurer United States	14.64

Battery for two 8-inch rifles on disappearing carriages.—On July 1, 1899, there remained to complete this battery only the mounting of the guns, the erection of hand railing, and some pipe connections. This was done during the year. (See "Preservation and Repair of Fortifications," this report.) The guns were received November 13, 1899, and mounted, and the battery was turned over to the artillery arm of the service March 21, 1900, in accordance with authority of the Secretary of War dated February 23, 1900.

Money statement.

July 1, 1899, balance unexpended	$439.44
June 30, 1900, amount expended during the fiscal year	419.48
January 30, 1900, balance unexpended	19.96
February 10, 1900, deposited to credit of Treasurer United States	19.96

Preservation and repair of fortifications.—A machinist was employed to care for the electric-light plants until the detail of an electrician sergeant relieved him of this duty in November, 1899. He has since been engaged in caring for and repairing property injured by the explosion of June 20, 1899 (see Report of Chief of Engineers for 1899, p. 922), and in work connected with torpedo material.

With the funds allotted for care of material injured by the explosion, all material not hopelessly destroyed was collected, cleaned, repaired, and stored.

The wharf was repaired, the cut and washed slopes of the 12-inch battery, mortar battery, and 10-inch battery were quite extensively repaired, and new sod and Bermuda grass sprouts placed where needed. Doors of the batteries were repaired in several instances; speaking tubes repaired, altered, and labeled; broken lift at the 10-inch battery repaired; steel hoods placed over exposed doors to prevent ingress of rain water; plumbing repaired at the 10-inch battery, where several pipes had been burst through freezing; drainage holes drilled in several places in magazines and platforms to carry off surface water; several electrical instruments repaired on switch boards, and some places where concrete of parapet was broken restored.

An estimate was made for preventing dampness in the 10-inch battery by coating exterior surface of concrete in front of magazines with asphalt. Owing to the expense, it was directed that the worst (as regards dampness) magazines be tried as an experiment; $2,176.90 was allotted; the sand filling was removed from the front of emplacement No. 4; the concrete face was coated with hot asphalt to below the level of the floor, a trench drain of broken brick laid against the asphalt, covered with a thin layer of gravel, and the filling replaced. In addition, the entrance was regraded with a fall to the rear, and two small wing walls built to prevent rain water entering from the sides. The dampness has not entirely disappeared, but water no longer drips from the ceiling as was common in the past.

The floors of all these batteries need renewing, in order to give a fall to the rear, and thus prevent water, entering from whatever cause, standing upon them. Settlement of the batteries has caused the floors in the magazines in most cases to be lower than the sills of the entrance doors.

In the 12-inch battery the electric plant is under the platform of gun No. 1 and has been continually wet in inclement weather. To remedy this evil, an oil coating was applied to the platform. The following extract from report of Lieut. Lewis H. Rand, Corps of Engineers, who had local charge, gives interesting details of the method employed:

> To remedy dampness in dynamo and storage-battery rooms, an oil coating was applied to the gun platform under which they are. An asphalt coating would be cut to pieces by the wheels of the ammunition trucks. A mixture of resin and boiled linseed oil in the proportion of 1 to 3 was applied. The platform was first carefully swept and cleaned; then clay forms one-half inch high were constructed by laying 1½-inch planks in the desired positions and building up against their edge the dampened clay to a thickness of about 3 inches; after the clay had dried and hardened the planks were removed. Diagonal rectangles, in checkerboard style of about 36 square yards each, were first treated. Twenty gallons of the mixture in a 55-gallon caldron were heated to a point such that the mixture was just short of boiling over, when it was poured out on the rectangle and spread with brooms to cover the entire surface. Warm, clear weather in a dry spell, so that the concrete might be as dry and absorbent as possible, was chosen for the work. After standing twenty-four hours the forms were removed and replaced for the uncoated rectangles with a lap of about 12 inches. After these were taken up the laps were again given a thin coating, simply poured on, as was also done to the steps and other irregular places where forms could not be constructed. After standing for some two weeks the thick unabsorbed resin was scraped off. The improvement in the dynamo room has been very noticeable, although the dripping water is not completely stopped. The space between two I-beams for a distance of about 6 feet is still damp, but the larger part of the ceiling is now dry and the dripping directly over the dynamo, which was the most objectionable feature, is completely stopped. Probably the water for the portion that drips comes through interstices from some other source.
>
> A coating was given over about 170 square yards at a total cost of about $70, and using altogether about 75 gallons of linseed oil and 25 of resin oil.

Two 8-inch B. L. rifles were received in November, 1899, for the 8-inch battery; these were mounted by engineer labor, under an allotment of $320 from the appropriation for "Preservation and Repair of Fortifications." While one of the guns was being carried by rail across a trestle over a small lagoon the trestle gave way and the gun, a locomotive, and three cars were precipitated into the water. An additional allotment of $120 was made for recovery of gun and plant, which was speedily effected. The gun was uninjured; the plant was repaired.

Some shore protection, in the form of sheet piling with string pieces bolted at the top, was placed along the left flank of the 15-pounder battery to prevent the cutting away of the beach, which had begun at that point. A portion of the slope also cut away was replaced.

A portion of the breast-height wall at Fort Barrancas, blown down during target practice, was rebuilt.

A fire chart of the entire harbor was prepared for the artillery, at a cost of $150.

Material for the electric plants was purchased and issued from time to time, upon duly approved requisitions to the artillery post engineer officer. Total cost of material so furnished, $136.52.

Money statement.

July 1, 1899, balance unexpended	$8,448.13
Amount allotted during the fiscal year	4,910.00
	13,358.13
June 30, 1900, amount expended during the fiscal year	8,927.90
July 1, 1900, balance unexpended	4,430.23
July 1, 1900, outstanding liabilities	816.42
July 1, 1900, balance available	3,613.81

Torpedoes for harbor defense.—Mining casemate: The doors of the mining casemate, blown off by the explosion of June 20, 1899, were replaced, shelves and tables erected as prescribed in Torpedo Manual, and the storage battery set up ready to receive the electrolyte.

Torpedo storehouse: This storehouse, destroyed completely by the explosion, was rebuilt exactly as it stood before, except that a corrugated-iron roof was substituted for the slate one. Portions of the old crane, shutters, and doors were utilized in rebuilding, and the old foundations were intact. Otherwise the structure is new. Cost of reconstruction, $5,066.02.

Cable tank: The wooden superstructure and windmill of the tank was completely destroyed by the explosion. A new windmill, duplicate of the old, has been set up, and the tank house rebuilt exactly as it originally stood, except that the house extends beyond the tank at the north end over a railroad track in the form of a porte-cochere; the rails of the traveling crane extend the entire length of the building, and the handling of cable drums is much simpler than in the first arrangement. Cost of reconstruction, $2,227.56.

Searchlight plants: The plant at one side was transferred to the artillery arm with the 8-inch battery. Of the plant at another side, the projector itself was completely destroyed by the explosion, and other parts injured. The dynamo has since been repaired and is in serviceable condition. The switchboard was damaged, but has been repaired as far as practicable without purchase of new parts.

Money statement.

July 1, 1899, balance unexpended	$26.27
Amount allotted during the fiscal year	8,040.00
	8,066.27
June 30, 1900, amount expended during the fiscal year	7,299.70
July 1, 1900, balance unexpended	766.57
July 1, 1900, outstanding liabilities	34.44
July 1, 1900, balance available	732.13

3 Q.

DEFENSES OF MOBILE AND MISSISSIPPI SOUND.

Officer in charge, Maj. William T. Rossell, Corps of Engineers; assistant, Lieut. James B. Cavanaugh, Corps of Engineers, until June 9, 1900; Division Engineer, Col. Peter C. Hains, Corps of Engineers.

Mortar battery.—The approved project provides for the construction of a battery for eight 12-inch B. L. steel mortars, at an estimated cost of $140,000.

At the beginning of the fiscal year the building plant had been installed; the greater part of framing for concrete erected; considerable sand filled in the parapet; low land in the rear filled to the level of the parade, and the eight mortar carriages and a large amount of materials for construction received. About 25 per cent of the concrete was placed. The platforms proper had been completed, and were in readiness for assembling the carriages.

During the fiscal year the battery was completed, except the sand parapet and a few minor details, the operations being as follows: 7,831.49 cubic yards concrete placed, including 4,213 square yards granolithing, using 8,510 barrels cement, 4,048 cubic yards sand, 6,363 cubic yards gravel, and 420 cubic yards (net) stone, completing concrete work except observation stations and adjacent stairways.

Proportions for concrete were 1 barrel of cement, 15 cubic feet of sand, and 27 cubic feet of gravel. For granolithing, twice the amount of cement was used. Concrete bars of the former, 7 months old, 8 inches by 8 inches cross section, developed a transverse breaking strength of 1,945 pounds, with a center quiescent load in a span of 4 feet; of the latter, 2,631 pounds. A granolith walk 10 feet wide extends the whole length of the battery. Speaking tubes connecting the principal stations were placed, trolleys and trolley beams installed, doors constructed and hung, and all wood and iron work painted, using cork paint for the ceiling beams.

To protect the rooms from moisture, air spaces extending above the level of the ceilings were placed in all thick walls, and the layers of concrete slope slightly away from the rooms in all directions. The platforms drain toward the sides and rear of battery and have suitable gutters. The top of the battery was covered with four thicknesses of tarred felt, laid separately in hot asphalt. This was covered with a 4-inch layer of granolith to protect it from injury. Very thin grout was applied with a brush to all the walls to diminish their porosity, and all exterior walls in contact with the sand parapet were, in addition, treated with a solution of soap and a solution of alum, applied alternately. No moisture has yet appeared in rooms, except that due to condensation, although recently tested by a succession of violent rains.

An electric plant, consisting of a General Electric 20-kilowatt generator, direct coupled to an automatic 9 by 7 engine of the marine type, a Lidgerwood vertical boiler, a 60-cell lead chloride storage battery with a normal discharge of 40 amperes, a combination switchboard, five ventilating fans, iron-armored conduit, junction boxes, wire, lamp fixtures, etc., was received and installed, with the exception of a few minor details. All lamp fixtures in magazine, shot rooms, and galleries are provided with guards and shades and are moisture proof. The storage-battery room is situated on the extreme flank, and is well ventilated. The pumping well for the boiler feed is situated directly in rear of the boiler room. The battery is connected with switchboard in dynamo room by means of lead cables laid in an underground 6-inch conduit. Lead cables were also laid in an underground 12-inch conduit extending the entire length of battery, with brick manholes at intervals, from which branches of 6-inch conduit were laid.

Each mortar pit is drained by a 4-inch sewer-pipe line with two branches, one leading directly into the sand beneath and the other to the rear.

The lower portions of the eight mortar carriages were moved to the battery, the base rings leveled and set, and the carriages assembled to the height of the loading platform. This included racers, azimuth circles, floor plates, and all ironwork built into the concrete.

Considerable delay and extra expense were entailed on account of the Atlas Cement Company not delivering cement promptly. This was partly due to the loss by that company of two vessels loaded with cement en route from New York. Work of concreting was suspended from August 4, 1899, to October 25, 1899, and from November 18, 1899, to January 29, 1900, on account of not having cement. Work on the sand parapet was continued during the greater part of this time. Concrete work was practically completed February 27, 1900. The actual time of placing the concrete for the entire battery occupied about four and one-half months.

The amount of sand placed in the sand parapet during the year is 40,638 cubic yards.

Money statement.

July 1, 1899, balance unexpended	$100,566.31
June 30, 1900, amount expended during fiscal year	89,335.42
July 1, 1900, balance unexpended	11,230.89
July 1, 1900, outstanding liabilities	1,600.00
July 1, 1900, balance available	9,630.89

Abstract of proposals for furnishing electrical storage batteries and combination switchboards for mortar battery and 6-inch gun battery, opened August 23, 1899.

No.	Name and address of bidder.	Chloride storage batteries.			Combination switchboards.		
		No.	Rate.	Amount.	No.	Rate.	Amount.
1	The Electric Storage Battery Co., Philadelphia, Pa	2	$1,898.70	$3,797.40	2	$750.00	$1,500.00

Battery for two 12-inch rifles.—The approved project provides for the construction of two emplacements for 12-inch B. L. rifles mounted on disappearing carriages, at an estimated cost of $160,000.

At the beginning of the fiscal year the battery had been completed, with the exception of the sand parapet and a few minor details.

During the fiscal year the battery has been completed, and was turned over to the artillery on June 4, 1900. The operations in detail are as follows: Five 8-inch converted rifles and three 200-pounder Parrott guns, with their carriages, were moved from the parapet of old fort in front of battery to the foot of the glacis east of the sally port and parked. The work of removing the parapet of the old fort in front and on flanks was completed, and 1,310 cubic yards of sand, loam, and masonry taken from it were filled in parapets and casemates, and behind brick retaining walls at entrance of casemates where necessary. The sand parapet was graded, loam saved from the parapet of old fort spread over top, and after being fertilized, 4,620 square yards of sod was placed, using 583 cubic yards of Bermuda sod, purchased for the purpose. The concrete retaining wall on east flank was completed upon removal of railroad trestle used for filling sand in parapet. Brick retaining walls were constructed on the flanks at the junction of old parapet with sodded slopes.

Steel doors for ammunition hoists and passageways leading to gun platforms were received and hung, and copper door hoods placed over all exterior doors. The railroad for handling ammunition was extended and connected with the line leading to wharf. The gravel walk with brick border was extended to the entrance of old fort. All ironwork of battery was repainted, the ceiling beams with cork paint.

The installation of electric plant was completed, and same cared for.

The 12-inch rifles were received and moved off the engineer wharf, after which the artillery garrison took charge of them. Their carriages were cleaned and the bright work coated with lead and tallow to prevent rusting. The base ring for east emplacement was leveled and grouted. Mechanics detailed by the Ordnance Department are making corrections on that for west emplacement previous to leveling it.

Money statement.

July 1, 1899, balance unexpended	$6,653.61
June 30, 1900, amount expended during fiscal year	6,147.40
July 1, 1900, balance unexpended	506.21
July 1, 1900, outstanding liabilities	267.57
July 1, 1900, balance available	238.64

Emplacements for 15-pounder rapid-fire guns.—The approved project provides for the construction of emplacements for two 15-pounder rapid-fire guns, at an estimated cost of $9,000.

At the beginning of the fiscal year plant for handling material had been prepared and work commenced on battery. Framing had been erected for concrete and placing concrete begun.

During the fiscal year this battery was completed and was transferred to the artillery on June 4, 1900. The operations were as follows: 549.18 cubic yards concrete placed, including 392 square yards of granolith, using 668 barrels cement, 286 cubic yards sand, 401 cubic yards gravel, and 25 cubic yards (net) stone.

The concrete was all hand mixed, the proportions for same being similar to those for mortar battery. A concrete retaining wall 4½ feet high, with riprap at its base, was built along the entire front to protect sand parapet from spray breaking over the sea wall. All parts of the battery have sufficient slopes for drainage, the areaways being drained by independent lines of 4-inch sewer pipe opening into a well constructed in the rear. Air spaces extending above the level of the ceilings were built in all thick walls adjacent to rooms to prevent dampness; care was also used to have the layers slope away from the rooms. A waterproof course, consisting of four thicknesses of tarred felt, laid separately in hot asphalt and draining into the air spaces, was put in the concrete above the ceilings. The minimum space allowed between the edge of the asphalt and exterior walls was 18 inches. This space in the vicinity of platforms was treated with solutions of soap and alum, alternately, as an additional precaution. The rooms have been in excellent condition for the past six months, no leaks having appeared.

The magazines are lighted by electricity, the current being supplied by the electric plant of the 12-inch battery, through an underground lead-covered cable 656 feet in length laid in a 6-inch conduit with brick manholes at the terminals. All wiring is laid in iron-armored conduit. The door openings are brick trimmed. All wood and iron work has been painted, using cork paint for the ceiling beams.

For sand parapet and foundations, 2,188 cubic yards of sand was used; for concrete, 286 cubic yards; for grading rear, 89 cubic yards, and for grading front, 20 cubic yards. Of the total quantity, 2,111 cubic yards of sand was hauled from the sand pit, about a mile distant from site of battery; the remainder from the immediate vicinity.

The amount of sod required for slopes on this battery was 1,103 square yards, including some resodding on the 4.7-inch rapid-fire battery, rendered necessary through change of slopes. Some of the old sod was saved and used again, which, with the 134.6 cubic yards of Bermuda sod purchased, was found to be sufficient.

Money statement.

July 1, 1899, balance unexpended	$8,644.89
June 30, 1900, amount expended during fiscal year	8,644.89

Preservation and repair of fortifications.—At the beginning of the fiscal year a balance of $1,249.51 was available from the allotment of the previous year for preservation and repair of fortifications at one of the sites. With this balance all sodded slopes were repaired, weeds removed, ground fertilized, and Bermuda grass planted in spots where grass had died. Reservation fences were repaired. The old fort was cleaned out and the drains kept open. Carriages for the mortar battery were cleaned and a coat of lead and tallow applied to bright work to prevent rusting. Ceiling beams of rooms of 4.7-inch rapid-fire battery were cork-painted and the concrete surface over the rooms waterproofed, using the same preparations as for similar work on the 8-inch battery. All necessary labor was furnished the Ordnance Department for raising, resetting, and regrouting base circles of the battery. A motorman for hoisting engine was furnished the artillery for moving the two 12-inch guns.

Care of submarine mine material: By indorsement of the Chief of Engineers, dated August 10, 1899, $100 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for care of submarine-mine material. Under this allotment all torpedo materials were examined and received such treatment as their preservation demanded. All the delicate instruments and materials were removed from their air-tight, copper-lined boxes, cleaned, dried, repacked, and boxes resealed. The cable tank was drained, cables tested, reinsulated, and tank refilled.

Repair of 8-inch battery: By indorsement of the Chief of Engineers, dated August 19, 1899, $1,000 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, for repair of the 8-inch battery. The concrete surface over the rooms of this battery was waterproofed, using asphalt, soap, alum, and linseed oil for the purpose. The storage battery of electric plant was repaired, and a copper canopy placed over it. Drains and gutters were constructed for counterweight wells, and loading platforms of emplacements Nos. 3 and 4 with copper flashing and iron cover plates where necessary.

At the beginning of the present fiscal year a balance of $574.66 was available from previous allotments for preservation and repair of fortifications at another site. With these funds sea wall and jetties were repaired, 240 tons of granite being used in this work; 200 cubic yards of old masonry, which had been blasted and removed from site of 6-inch battery, was dumped along face of sea wall and jetties. Drain ditch around fort was kept open; windmill for emptying ditch kept in repair, and disinfectants used in old casemates and drains.

By letter of the Chief of Engineers, dated June 9, 1900, allotments were made from the appropriation for "Preservation and Repair of Fortifications," act of May 25, 1900, as follows:

For necessary miscellaneous repairs at one site	$1,500
For necessary miscellaneous repairs at another site	800

Money statement.

July 1, 1899, balance unexpended	$2,518.69
Amount allotted during fiscal year	3,400.00
	5,918.69
June 30, 1900, amount expended during fiscal year	3,400.08
July 1, 1900, balance unexpended	2,518.61
July 1, 1900, outstanding liabilities	243.52
July 1, 1900, balance available	2,275.09

Shore protection.—Under allotment made by letter of the Chief of Engineers, dated August 8, 1898, of $20,000, from appropriation for "Sea Walls and Embankments," act of May 7, 1898, a contract was entered into with J. M. Walsh on November 1, 1898, for the construction of about 1,800 linear feet of shore protection. Under this contract 850 linear feet of sea wall was entirely completed, and fascine mattress sunk for an additional distance of 850 feet on June 30, 1899. During fiscal year ending June 30, 1900, 2,667 cubic yards rock and 3,565 square yards of mattress were put in place, finishing 950 linear feet of sea wall and completing the work under this contract by the construction of a total of 1,800 linear feet of sea wall. On November 1, 1899, a contract was entered into with W. Chase Spotswood for extending the sea wall 800 to 1,000 feet eastward, which will place the terminus at the quarantine wharf. Under this contract 1,167 square yards of mattress and 548 cubic yards of rock have been put in place, entirely completing 370 linear feet of sea wall and sinking the mattress for an additional distance of 155 linear feet. Under the terms of this contract work was to be completed June 30, 1900, but owing to excessive high water which prevailed on the rivers of Alabama during the past spring the necessary fascines could not be secured in time, so a request was made for an extension of thirty days' time, and was granted by indorsement of the Chief of Engineers, dated June 16, 1900.

The sea wall is 4 feet high, with flat crest 4 feet wide; shore slope, 1 on 1; sea slope, 1 on 2; constructed of stone weighing from 10 to 500 pounds, the largest being placed on crest and sea slope, hand laid to approximately smooth surface; all overlaying a fascine mattress 20 feet wide and 9 inches thick.

Money statement.

July 1, 1899, balance unexpended		$20,582.32
June 30, 1900, amount expended during fiscal year		12,998.72
July 1, 1900, balance unexpended		7,583.60
July 1, 1900, outstanding liabilities	$239.81	
July 1, 1900, amount covered by uncompleted contracts	7,000.00	
		7,239.81
July 1, 1900, balance available		343.79

Abstract of proposals for construction of shore protection, opened October 20, 1899.

No.	Name and address of bidder.	Stone in place, per cubic yard.	Fascine mattress in place, per square yard.	Time of commencement and of completion.
1	W. Chase Spotswood, Mobile, Ala.	$3.25	$0.75	In accordance with specifications.

Contract in force.

With W. Chase Spotswood, dated November 1, 1899, approved by the Chief of Engineers November 11, 1899, for construction of shore protection at the rate of 75 cents per square yard for fascine mattress in place and $3.25 per cubic yard for stone in place. Work commenced June 1, 1900, and not yet completed.

Construction of a concrete cable tank, and repair of casemates for storage of torpedo materials.—At the beginning of the fiscal year the concrete cable tank and repairs to casemates were completed. During the fiscal year a half mile of multiple cable was received; searchlight plant was crated and stored. These works being completed, on August 21, 1899, balance of allotments, amounting to $463.93, was turned back into the Treasury.

Money statement.

July 1, 1899, balance unexpended		$469.43
June 30, 1900, amount expended during fiscal year	$5.50	
Amount returned to United States Treasury, work being completed	463.93	
		469.43

Emplacements for 6-inch guns.—The approved project provides for the construction of emplacements for two 6-inch quick-fire guns mounted on United States disappearing carriages, at an estimated cost of $55,000. This estimate was subsequently increased by $15,000.

At the beginning of the fiscal year only some preliminary work had been done looking to securing materials and supplies.

Work was commenced July 17, 1899, with a small force, and has been continued with but one interruption of six days. The work was delayed somewhat by the slow arrival of cement, which was expected two months before it was received, and of gravel, the delivery of which could not be made on account of the gravel beds being flooded by high water on the Tombigbee River, and awaiting different parts of plant.

The following items of plant were transferred from other works to the site of these emplacements:

One light locomotive.

Mixing plant complete, with steam boiler, pump, horizontal driving engine, and hoisting engine.

Rails for one-fourth mile railroad track.

Water tank (about 5,000 gallons).

In addition there were purchased for this work materials for one-fourth mile railroad track and for 10 new railroad cars; ironwork and timbers for 4-ton crane derrick and for rebuilding derrick on wharf; one rotary swinging engine for crane derrick; one cypress water tank (3,000 gallons).

A cement warehouse 96 feet by 40 feet was built, with railroad track running through center; capacity, 3,000 barrels. A small house was built as quarters to accommodate 16 men. This, with other buildings, afforded quarters for 35 men.

A trestle 300 feet long was built for unloading gravel in rear of concrete plant. This has since been extended 150 feet over battery for filling sand in parapet.

The concrete mixer used was a 4-foot cubical box mixer, driven by 8-horsepower Lidgerwood engine, by cog gearing and friction clutch. Steam was supplied for this engine by an upright Lidgerwood boiler, which also supplied a hoisting engine for hoisting cement to platform over mixer. Gravel and sand were hoisted to platform in dumping buckets by crane derrick, which also handled concrete from mixer to walls of battery. This derrick was driven by large double-drum hoisting engine and rotary swinging engine, steam for both being supplied from same boiler. The regular charge for concrete was 27 cubic feet gravel, 15 cubic feet sand, and 1 barrel cement. The extreme capacity of this plant was not over 110 cubic yards concrete per day of eight hours, but it was well suited to the work, as it could be operated up to its full capacity by a very small force. The cement used was Atlas and Lagerdorfer Portland cement; the gravel was brought from about 100 miles north, on Tombigbee River; the sand was secured about 800 feet from site of battery.

While plant was being erected, a force was kept at work excavating for foundation of battery, 6,233 cubic yards of earth and sand was excavated from site, and 378 cubic yards of old masonry blasted out from old gun platforms and breast-height wall across site.

The following materials were received and part of them stored before and during construction of battery:

Three thousand five hundred and twenty-two and one-half cubic yards gravel, 85 cubic yards broken stone (used and paid for as gravel), 5,995 barrels Atlas and Lagerdorfer Portland cement, 165,000 feet B. M. lumber for concrete framing, trestle, warehouses, and quarters, 107.5 tons coal, 23 tons steel roof beams, 30 barrels asphalt cement, 100 rolls roofing paper, materials for electric plant, including dynamo, boiler, storage battery, and iron-armored conduit. Also all material for ammunition hoists and trolley system.

The construction of this battery was carried on over the entire area at once, the concrete being placed as nearly as possible in horizontal layers. The whole foundation was first graded, floors of rooms put in, and forms for rooms and galleries built on these floors. Concrete work was then brought up to ceiling level of rooms over all area except gun platforms, which were the last completed. Steel roof beams were placed over all rooms and iron-armored conduit for electric wires placed immediately over beams. Concrete was then placed to a sufficient thickness to cover beams, and arched and smoothed off. On this surface was applied a waterproof coating consisting of four layers of roofing paper, and about one-fourth inch of asphalt cement, placed in alternate layers. Laying paper was begun from foot of slopes, each successive layer overlapping. The slopes were so arranged as to drain into and beyond the air spaces. The asphalt cement was applied at a temperature of 300° to 350° F.

The air spaces were formed by two walls of 1 by 12 inch plank, separated by short lengths of 2 by 2 inch scantling, so breaking joints as to allow a free circulation through the whole. Ventilation was obtained by running 4-inch glazed tile through walls to open air.

For speaking tubes, which connect magazines, loading platforms, observation stations, and relocator room, 1¼-inch galvanized iron pipe was used. All speaking tubes and electric conduit were imbedded in concrete walls, and all so arranged as to drain toward openings.

Ring bolts were placed at convenient intervals along parapet walls in front of platforms for use in mounting and handling guns and carriages. Recesses for ladders from platform to parapet were sunk in walls, 1-inch galvanized iron being used for rungs.

All slopes for drainage on floors, platforms, and top of parapet were made as simple as possible; floors of magazines, shell room, and ammunition-lift room drain to tile in center of room; this tile penetrates through floor and foundation into sand below; top to be covered by perforated iron plate All platform rooms, dynamo room, and surface of loading platforms drain straight to the rear. Top of parapet drains straight to the front and ends. Gun platforms drain into counterpoise wells, which have 6-inch opening into sand below and also a connection for drainage under floor of platform rooms to rear face of battery.

There have been placed 4,300 cubic yards of concrete, using 5,137 barrels cement, 2,161 cubic yards sand, 3,029.5 cubic yards gravel, and 85 cubic yards broken stone. This completes the concrete work of the battery, except four flights of concrete steps and walk in rear of battery. A large part of the concrete framing has been removed from outer walls and rooms.

There yet remains to be done on this battery:

Filling in sand for parapet; sodding slopes of parapet; concrete steps and walk in rear of battery; steel platforms and stairs in rear of battery; installation of electric plant, ammunition hoists, and trolleys; receiving and erecting ammunition cranes and platform railings; fitting up doors and windows; cleaning up and coating walls with cement wash.

Owing to the large and general rise which took place in the prices of almost all materials and supplies used in the construction of this battery, together with the irregular and unsatisfactory delivery of materials, due partly to lack of storage facilities, it was found necessary to ask an allotment of $15,000, in addition to $55,000 already allotted, to complete work on the battery. This allotment was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, by indorsement of the Chief of Engineers, dated April 21, 1900.

Money statement.

July 1, 1899, balance unexpended	$55,000.00
Amount allotted during fiscal year	15,000.00
	70,000.00
June 30, 1900, amount expended during fiscal year	55,070.09
July 1, 1900, balance unexpended	14,929.91
July 1, 1900, outstanding liabilities	131.95
July 1, 1900, balance available	14,797.96

Abstract of proposals for furnishing and delivering cement and gravel, opened August 3, 1899.

No.	Name and address of bidder.	Cement.				Gravel.		
		Brand.	Number of barrels.	Price per barrel.	Amount.	Number of cubic yards.	Price per cubic yard.	Amount.
1	W. Chase Spotswood, Mobile, Ala.					4,000	$1.88	$7,520.00
2	Henry L. Wilson, Mobile, Ala.					4,000	2.075	8,300.00
3	Fred. Visscher, Flomaton, Ala.					4,000	2.00	8,000.00
4	A. C. Danner, Mobile, Ala	Lagerdorfer	6,000	$2.85	$17,500			

Supplies for coast defenses.—By letter of the Chief of Engineers dated June 7, 1900, $600 was allotted from appropriation for "Supplies for Coast Defenses," act of May 25, 1900, for the purchase of material to be supplied by the Engineer Department for the service of the coast artillery during the fiscal year 1901.

As yet no expenditure has been made from this allotment.

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DEFENSES OF NEW ORLEANS, LA., AND SABINE PASS, TEXAS.

Officers in charge, Maj. James B. Quinn, Corps of Engineers, until December 1, 1899, and Maj. Henry M. Adams, Corps of Engineers, since that date; assistant, Lieut. Clarke S. Smith, Corps of Engineers, until August 10, 1899; Division Engineer, Col. Henry M. Robert, Corps of Engineers.

NEW ORLEANS, LA.

Emplacements for two 15-pounder rapid-fire guns, first battery.—Work on these emplacements was commenced on December 28, 1898, with funds allotted from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898. At the beginning of the fiscal year the emplacements were practically completed, with the exception of the gun platforms, which awaited the arrival of the mounts.

During the past year the earth slopes of the battery were repaired, the battery was wired for electric lights, and a walk constructed connecting the battery with the 8-inch and 10-inch batteries. No guns and no carriages have been received. The sum of $23,711.92 has been expended on these emplacements, and $788.08 remains available for mounting the guns and carriages.

Permanent housing of electric plant.—The construction of a shelter for the electric-light plant was authorized on May 26, 1899, to replace a concrete building constructed in 1898. The thickness of the walls and arches of the new structure were increased to 3 feet, and the building located in a retired spot, upon the foundations of unused gun platforms, which were strengthened with grillage timbers and concrete. The work was commenced in June and completed in August, 1899. This casemate is constructed of concrete, with an arched roof and cement floor. The dynamo, boiler, and engine were moved in and placed upon their foundations, and were thoroughly overhauled, repaired, and painted. Poles were set up in the fort and strung with lead wires for the batteries and searchlight. The field magnet was rewound and the dynamo room and switchboard wired. The ammeter and voltmeter were repaired and recalibrated. The exterior of the building was coated with a mixture of tar and asphalt, and an oil heater placed in the dynamo room. The plant was cleaned and operated several times, and such repairs as were necessary were made. The plant was transferred to the garrison on October 25, 1899. The cost of the shelter was $2,369.

Hand rails for new emplacements.—The sum of $250 was allotted on January 12, 1900, from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899, to be applied to placing hand rails around the loading platforms of the modern emplacements. With this allotment two hand rails were purchased and placed on the 10-inch emplacements, at a cost of $216, and one hand rail was placed on an 8-inch emplacement, at a cost of $34.

Preservation and repair of fortifications.—The sum of $1,870 was allotted on June 9, 1899, from this appropriation, act of May 7, 1898, to be applied to preservation and repair of fortifications at this locality for the fiscal year ending June 30, 1900.

Commencing in July, 1899, the grass and weeds have been regularly cut. The crossheads of one 10-inch B. L. rifle were repaired, and the base rings of the two 8-inch B. L. rifles were releveled. Hand-extension pieces were placed on ladders leading from gun platforms to superior slope of the 10-inch battery. The superior slopes of the 8-inch and 10-inch batteries were painted. The cistern, mess hall, and blacksmith shop were painted, and the machinery of the working plant cleaned and painted. Shelter was built over the two hoisting engines, and the derrick was dismantled and stored. Buildings were provided with doors and windows where necessary. The settlements and rain washes in the earth slopes and 400 feet of the levee were repaired and sodded. The electric-light plant was cleaned and cared for, and was run and tested at intervals. Two starting rheostats were provided for use with the ammunition hoists of the 10-inch B. L. rifles. Some dampness having appeared in the dynamo room of the electric-light plant a coal-oil heater was placed in it.

Leveling gun platforms, etc., of new batteries.—An allotment of $6,545 was made on July 22, 1899, from the act of March 3, 1899, to be applied to leveling the gun platforms and rendering the magazines and passageways of the new batteries dry.

Prior to the commencement of this work the unequal settlement of the 10-inch emplacements, which were built in 1897, had caused the different masses of concrete of which they were composed to separate, so that water penetrated through the vertical joints left as planes of weakness. The gun platforms sloped toward the parapet, causing water to collect on the platforms. The floors of the magazine sloped toward the front of the battery, preventing drainage of the water which entered through the passageways. The uneven settlement of the 8-inch battery also interfered with drainage, and the gun platforms sloped toward the front of the battery and required releveling. The following work was done with the funds allotted:

Ten-inch emplacements: A blind drain was laid between the concrete and earth parapet. Cracks in the gun platforms were filled with a mixture of asphalt and tar. The calking between the iron plates covering the passageways was removed and replaced with lead. The iron plates covering the shot rooms were raised to prevent water from collecting on the gun platforms. Several new drains were cut in the floors of the battery and of the passageways. The floors of four magazines were raised and leveled. Drains were cut in the superior slope of the traverse. The magazines have kept perfectly dry since the blind drain was placed between the concrete and earth parapets, and the drainage of the battery is much improved.

Eight-inch emplacements: The two gun platforms were releveled, and the floors of the magazines raised to secure better drainage. About 1,785 square feet of concrete was placed on the superior slope. A blind drain was laid between the concrete and earth parapet, which has effectually prevented dampness in the magazines. Coamings were built around the openings leading from the superior slope to the magazines and in front of the trap doors of the ammunition hoists.

The entire cost of this work was $6,545.

Leveling base rings of 10-inch battery.—An allotment of $400 was made August 18, 1899, from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1899, to be applied to raising and leveling the base rings of the 10-inch battery. This work was completed in November, 1899, at the estimated cost.

Money statements.

GUN AND MORTAR BATTERIES.

Emplacements for two 15-pounder rapid-fire guns.

July 1, 1899, balance unexpended	$2,513.92
June 30, 1900, amount expended during fiscal year	1,725.84
July 1, 1900, balance unexpended	788.08

Permanent housing of electric plant.

July 1, 1899, balance unexpended	$2,252.56
June 30, 1900, amount expended during fiscal year	2,252.56

Hand rails for new emplacements.

January 12, 1900, amount allotted	$250.00
June 30, 1900, amount expended during fiscal year	250.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

For fiscal year 1900.

July 1, 1899, balance unexpended	$1,870.00
June 30, 1900, amount expended during fiscal year	1,870.00

Leveling gun platforms, etc., of new batteries.

July 22, 1899, amount allotted	$6,545.00
June 30, 1900, amount expended during fiscal year	6,545.00

Leveling base rings of 10-inch battery.

August 18, 1899, amount allotted	$400.00
June 30, 1900, amount expended during fiscal year	400.00

Emplacements for two 15-pounder rapid-fire guns, second battery.—The sum of $24,500 was allotted on December 20, 1898, for the construction of two emplacements for 15-pounder rapid-fire guns on pillar mounts. Work on these emplacements was commenced December 28, 1899, and at the beginning of the fiscal year the emplacements were far advanced. Practically no work remained to be done except on the gun platforms, which can not be completed until the carriages are received. (See Annual Report of the Chief of Engineers, Seacoast Defenses, 1899, p. 940.)

During the past year the battery was wired for electric lighting, the earth slopes were repaired, a concrete walk was laid in the rear of the emplacements, and the parade graded. No guns and no carriages have been received. The gun platforms of the emplacements remain uncompleted. The sum of $22,847.38 has been expended on this work, and $1,652.62 remains available.

Mounting two 8-inch B. L. rifles on disappearing carriages.—This work consisted in dismounting two 8-inch B. L. rifles from old converted carriages and mounting them on new disappearing carriages. The removal and remounting were completed on June 2, 1899. A balance of $318.44, remaining from the allotment on July 1, 1900, was utilized in the payment of outstanding bills and in cleaning and leveling the carriages.

Ammunition hoists for 8-inch battery.—At the beginning of the present fiscal year the 8-inch battery was completed, with the exception of the ammunition hoists, for which no provision had been made. The sum of $600 was allotted on August 18, 1899, from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, to be applied to this purpose. Eight triplex spur-gear blocks, of one-half ton capacity and 13-foot hoist, and an equal number with 5-foot hoist, were purchased and installed in October, 1899.

Removing old brick parapet.—On December 26, 1899, the Secretary of War authorized the removal of so much of the old fort and its adjacent batteries as prevented a clear view of the river from the battery of two 8-inch B. L. rifles, and the sum of $4,848 was allotted from the appropriation for "Gun and Mortar Batteries," act of March 3, 1899, to be applied to that purpose.

This work was commenced on January 8 and completed February 28, 1900. A portion of the old brick parapet and an old magazine on the parapet were blasted and removed. About 4,000 cubic yards of earth were removed from the tops of five old magazines and 650 feet of trestle was torn down and the lumber and piling stored. Thirteen obsolete guns and carriages were dismounted and moved.

The cost of blasting the concrete and granite was greater than under ordinary circumstances, as small charges of explosives were used owing to the proximity of the modern batteries. The total cost of the work was $2,279.71, the balance of the allotment being returned to the Treasury on May 25, 1900.

Preservation and repair of fortifications.—The sum of $3,025 was allotted on June 9, 1899, from act of May 7, 1898, to be applied to preservation and repair of fortifications, including care of the modern guns, carriages, and electric-lighting plant at this fort for the fiscal year, 1900.

Commencing in July, 1899, the grass and weeds have been regularly cut. The superior slopes of the 8-inch and 15-pounder rapid-fire batteries were painted; the iron work of the 8-inch battery, the pile-driver framework, steam hammer, two derricks, and three hoisting engines were cleaned and painted to prevent rust. Shelters were built over the principal parts of the working plant to protect them from the weather, and a large quantity of engineer property was transferred to a site where the facilities for storage are better. The oil engine and rotary transformer were repainted and coated with cosmic. A large quantity of wire rope was tarred and stored. Torpedo junction boxes were painted and torpedo material cleaned and stored. The two 8-inch B. L. rifles were cleaned and cared for until transferred to the garrison on October 25, 1899. The earth protection in front of the 15-pounder rapid-fire emplacements was graded and earth placed along the entire exterior crest of the 8-inch battery. The electric-light plant was cleaned and tested at intervals. Some dampness having appeared in the dynamo room of the electric plant, the room was provided with an air-tight door and a coal-oil heater, and several drains were cut around it.

Other minor repairs were made during the year.

Leveling platforms of two 8-inch B. L. rifles: The sum of $385 was allotted on July 22, 1899, from act of March 3, 1899, which was applied, as designated, to leveling the gun platforms of two 8-inch B. L. rifles. The necessity for this work arose from unequal settlement of the emplacements.

Moving torpedo material: On August 4, 1899, an allotment of $600 was made from this appropriation, act of March 3, 1899, which was applied to moving the various topedo material on hand to a new storehouse. The removal was completed in October, 1899, upon the completion of the storehouse. The torpedo material had previously been stored in surrounding casemates and magazines, some of which were damp, requiring frequent cleaning and inspection of the material. The material is now in good condition.

Purchase of voltmeter: The sum of $29.50 was allotted on December 22, 1899, from act of May 7, 1898, which was applied to the purchase and installation of a new voltmeter for the electric-light plant, the old voltmeter having rusted and become unserviceable.

Hire of watchmen: The sum of $180 was allotted on May 1, 1900, from act of March 3, 1899, for the hire of day and night watchmen of the topedo property for the months of May and June, 1900. This was necessary in view of the fact that the engineer work previously provided for was completed and the employees discharged. The amount allotted was expended as indicated.

Construction of torpedo storehouse.—The sum of $3,675 was allotted on June 15, 1899, from the appropriation for "Torpedoes for Harbor Defense," act of March 3, 1899, to be applied to the construction of a torpedo storehouse. This storehouse is 26 feet wide, 67 feet 4 inches long, and 14 feet high to bottom of trusses. It has a wooden frame sheathed with corrugated iron, with a grillage and concrete foundation. The rooms have double walls with air space between. The building is located as safely as the fields of fire of the batteries and the proximity of the landing on the river bank will permit. It receives the benefit of the sun, and the torpedo material is maintained there in good condition.

Money statements.

GUN AND MORTAR BATTERIES.

Emplacements for two 15-pounder rapid-fire guns.

July 1, 1899, balance unexpended	$5,426.85
June 30, 1900, amount expended during fiscal year	3,774.23
July 1, 1900, alance unexpended	1,652.62

Mounting two 8-inch B. L. rifles on disappearing carriages.

July 1, 1899, balance unexpended	$318.44
June 30, 1900, amount expended during fiscal year	318.44

Ammunition hoists for 8-inch battery.

August 18, 1899, amount allotted	$600.00
February 26, 1900, deposited in United States Treasury	128.00
June 30, 1900, amount expended during fiscal year	472.00

Removing old brick parapet.

December 29, 1899, amount allotted	$4,848.00
May 25, 1900, returned to United States Treasury	2,568.29
June 30, 1900, amount expended during fiscal year	2,279.71

PRESERVATION AND REPAIR OF FORTIFICATIONS.

For fiscal year 1900.

July 1, 1899, amount unexpended	$3,025.00
June 30, 1900, amount expended during fiscal year	2,980.12
July 1, 1900, balance unexpended	44.88

Leveling platforms of two 8-inch B. L. rifles.

July 22, 1899, amount allotted	$385.00
June 30, 1900, amount expended during fiscal year	385.00

Moving torpedo material.

August 4, 1899, amount allotted	$600.00
June 30, 1900, amount expended during fiscal year	600.00

Purchase of voltmeter.

December 22, 1899, amount allotted	$29.50
February 26, 1900, returned to United States Treasury	.50
June 30, 1900, amount expended during fiscal year	29.00

Hire of watchmen.

May 1, 1900, amount allotted	$180.00
June 30, 1900, amount expended during fiscal year	90.00
July 1, 1900, balance unexpended	90.00
July 1, 1900, outstanding liabilities	90.00

TORPEDOES FOR HARBOR DEFENSE.

Construction of torpedo storehouse.

July 1, 1899, amount unexpended	$3,675.00
June 30, 1900, amount expended during fiscal year	3,675.00

SABINE PASS, TEXAS.

No fortification work was done at this place by the Engineer Department during the past fiscal year. A balance of $14.47 from an allotment of $110 from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, was expended in payment of debts previously incurred.

The four light bronze 12-pounder field guns and the 8-inch B. L. rifle, which were mounted on temporary platforms during the war with Spain, were withdrawn during the year, and the ordnance sergeant who has been in charge of the armament was relieved from the post on October 31, 1899.

The torpedo material, which was purchased in 1898, is stored and is in good condition.

Money statement.

July 1, 1899, balance unexpended	$14.47
June 30, 1900, amount expended during fiscal year	14.47

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3 S.

DEFENSES OF GALVESTON, TEX.

Officer in charge, Capt. Charles S. Riché, Corps of Engineers; Division Engineer, Col. Henry M. Robert, Corps of Engineers.

Emplacements for 10-inch guns, battery No. 1.—This battery was constructed by hired labor, and was designed for two 10-inch B. L. rifles on disappearing carriages, one all-round fire and one limited fire.

This battery was completed at the beginning of the present fiscal year, with the exception of the electric light and power plant.

The electric-light and power plant was installed during the year.

The total settlement of this battery is 1.54 feet, showing a tip of 0.41-foot from rear to front in a distance of 77 feet, or 0.005338 per foot. The drainage and ventilating system established during the fiscal year ending June 30, 1899, has worked satisfactorily during the present year. There is still some slight seepage, probably due to the porous quality of the Rosendale concrete. It is thought that this can be entirely remedied by excavating in front to floor level and plastering and asphalting wall in front of passage way and magazines.

This battery was constructed under the immediate supervision of Supt. W. A. Hinkle to April 8, 1898, of Inspector Abm. Cross from April 8, 1898, to December 31, 1898, and of Supt. W. A. Hinkle from January 1, 1899, to date of transfer to the artillery.

On October 25, 1899, this battery was transferred to the artillery for their care and use. No further reports concerning its construction will therefore be submitted.

The total cost of this battery was $117,500.

Power house at 10-inch battery No. 1.—This is a concrete, splinter-proof power house, built in rear of and adjoining the 10-inch battery.

This power house was practically completed at beginning of present fiscal year.

During the year the minor details of power house were completed and electric-light and power plant installed in same.

The cost of the power house was $2,500.

This work was constructed under the immediate supervision of Supt. W. A. Hinkle.

This power house was on October 25, 1899, transferred to the artillery for their care and use, and no further reports concerning its construction will therefore be submitted.

Money statement.

July 1, 1899, balance unexpended	$336.50
June 30, 1900, amount expended during fiscal year	336.50

Mortar battery No. 1.—This battery consists of eight 12-inch mortars, and was constructed under a contract entered into with Henry L. Breneman, of Paris, Tex. Work was commenced February 20, 1897, and was completed June 30, 1898.

This battery was completed at the beginning of the present fiscal year, with the exception of the electric-light and power plant.

The electric-light and power plant was installed during the year.

During the present fiscal year this battery has settled in pit A 0.07 foot and in pit B 0.12 foot, there being a tip toward northwest of 0.05 of 1 foot in 130 feet, or 0.000384 per foot. This slight settlement can not be detected in traversing the mortars. The drainage system established last year has worked satisfactorily during the present year. The magazines and rooms are now free from seepage and are dry.

This work was under the immediate supervision of Assistant Engineer S. M. Wilcox from February 27, 1897, to February 21, 1898; of Supt. W. A. Hinkle from February 21, 1898, to April 8, 1898; of Inspector Abm. Cross from April 8, 1898, to December 31, 1898; and of Supt. W. A. Hinkle from January 1, 1899, to date of transfer to the artillery.

On October 25, 1899, this battery was transferred to the artillery for their care and use, and no further reports concerning its construction will, therefore, be submitted.

Total amount expended to June 30, 1900, was $117,700.

Money statement.

July 1, 1899, balance unexpended	$353.53
June 30, 1900, amount expended during fiscal year	353.53

Two emplacements for 15-pounder rapid-fire guns, battery No. 1.—This battery is designed for two 15-pounder rapid-fire guns on pillar mounts, and was constructed by hired labor under an allotment from appropriation for "Gun and Mortar Batteries," act of July 7, 1898. The estimated cost of the battery was $30,000.

The condition of the work at the beginning of the present fiscal year was as follows: All material for construction had been received or contracted for and trestle constructed and pipe laid for filling the site for the battery. Alteration had been made in the U. S. dredge *Gen. C. B. Comstock*, so changing her that she could be used either as a stationary or seagoing dredge, to fill in the site for the battery.

During the present fiscal year the site for the battery was filled and the battery completed, and it is now ready for mounting guns. Up to the close of fiscal year guns had not been received.

The average total settlement of this battery is 0.28 foot, and the tip to the front is 0.01 foot.

On March 31, 1900, this battery was transferred to the artillery for their care and use, and no further reports concerning its construction will, therefore, be submitted.

The total amount expended on this battery to June 30, 1900, was $32,988.75, and was expended as follows:

Filling site:		
Changes in dredge *Comstock*, including labor	$5,682.83	
Trestle and pipe line:		
Pipe, pontoons, hardware, labor, etc	5,738.07	
Sand fill:		
Hardware, coal, etc	1,934.36	
Locomotive, and current expenses	1,007.27	
Galveston Wharf Company, use of pile driver	242.10	
Labor, superintendence, and office expenses	2,241.65	
		$16,846.28
Crushed stone		2,092.59
Sharp sand		489.45
Cement		1,799.00
Lumber		636.49
Piles		408.00
Ventilating pipes		31.15
Hinges		24.00
Hollow partition tiles		95.62
I-beams, and hand rails		143.76
Soil and sod		195.42
Damp courses		99.65
Electric wiring		74.00
Hardware, tools, repairs and fitting for locomotive		965.53
Plant		884.97
Labor, superintendence, and office expenses		8,202.84
Total cost to June 30, 1900		32,988.75

The method used in the construction of this battery is described in report of Supt. W. A. Hinkle, forwarded herewith, to which attention is invited.

This work has been under the immediate supervision of Supt. W. A. Hinkle, the filling of the site being in the immediate charge of Capt. George M. Prendergast, master of the U. S. dredge *Gen. C. B. Comstock*.

Money statement.

July 1, 1899, balance unexpended	$20,664.23
Amount transferred from allotment for two emplacements for 15-pounder rapid-fire guns, battery No. 2	1,500.00
Amount transferred from allotment for three emplacements for 15-pounder rapid-fire guns	1,500.00
	23,664.23
June 30, 1900, amount expended during fiscal year	23,652.98
July 1, 1900, balance unexpended	11.25
July 1, 1900, outstanding liabilities	11.25

Two emplacements for 15-pounder rapid-fire guns, battery No. 2.—This battery is designed for two 15-pounder rapid-fire guns on pillar mounts, and was constructed by hired labor under an allotment from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898. The estimated cost of the battery was $15,000.

Work on the battery was begun January 9, 1899, and the condition of the work at the beginning of the present fiscal year was as follows: All foundation piles driven and a grillage of old railroad iron laid on same; all concrete work completed, except setting castings on gun platform and building up blast surfaces; magazines had a damp course at the 8-foot elevation and an asphalt course at the 16.5-foot elevation, with a hollow-tile air space around them; all doors were hung and hand rails erected; sheet-piling revetment was completed.

During the present fiscal year this battery was completed with the exception of blast surfaces and part of the riprap protection, and is ready for mounting guns. Up to the close of the fiscal year guns had not been received. At close of present fiscal year riprap protection to sheet-pile revetment is being unloaded and placed.

The total average settlement of this battery is 0.03 foot, and the tip to front is 0.01 foot.

The amount expended to June 30, 1900, was $11,690.60, and was expended as follows:

Pile and grillage foundation	$492.10
Cement	1,781.60
Broken stone	2,298.27
Sharp sand	512.40
Sand fill and soil	1,188.79
Revetment sheeting	322.50
Lumber, casing, etc	192.78
Hollow partition tiles	110.50
Damp course	38.25
Asphalt course	66.90
Ventilating pipes	35.60
Door fittings	30.06
I-beams and hand rails	161.59
Switching charges	33.00
Electric wiring	73.00
Plant	241.48
Labor, superintendence, and office expenses	4,111.78
Total amount expended to June 30, 1900	11,690.60

The method used in the construction of this battery is described in report on 10-inch battery No. 2, Annual Report of the Chief of Engineers for 1899, page 959 et seq.

This work has been under the immediate supervision of Supt. S. W. Campbell to January 12, 1900, and of Supt. W. A. Hinkle to date.

Money statement.

July 1, 1899, balance unexpended	$5,128.97
Amount transferred to 15-pounder rapid-fire battery No. 1	1,500.00
	3,628.97
June 30, 1900, amount expended during fiscal year	1,819.57
July 1, 1900, balance unexpended	1,809.40
July 1, 1900, outstanding liabilities	632.91
July 1, 1900, balance available	1,176.49

Three emplacements for 15-pounder rapid-fire guns.—This battery is designed for three 15-pounder rapid-fire guns on pillar mounts, and was constructed by hired labor under an allotment from appropriation for "Gun and Mortar Batteries," act of July 7, 1898. The estimated cost of this battery was $30,000. Work on this battery was begun January 26, 1898, and the condition of the work at the beginning of the present fiscal year was as follows: Foundation piles driven, and grillage of old railroad iron placed on same; gun platforms ready for reception of guns and carriages.

During the present fiscal year this battery was completed, and is ready for mounting guns. Up to close of fiscal year guns had not been received.

The average total settlement of this battery is 0.91 foot, and tip of the battery toward the front is 0.28 foot.

The total amount expended on this battery to June 30, 1900, was $28,287.64, and was expended as follows:

Cement	$3,296.40
Crushed stone	1,276.93
Riprap for revetment	2,090.54
Sand fill and soil	1,053.90
I-beams	203.99
Hollow partition tiles	153.70
Foundation piles	194.40
Damp and asphalt courses	171.11
Door hinges	24.00
Hand rails	43.11
Drain pipes	65.83
Lumber	800.49
Electric wiring	78.00
Switching charges	366.14
Plant	1,363.78
Hardware, tools, etc	510.97
Labor, superintendence, office expenses, and subsistence	16,594.35
Total amount expended to June 30, 1900	28,287.64

The method used in the construction of this battery is described in report of Supt. W. A. Hinkle on two emplacements for 15-pounder rapid-fire guns, battery No. 1, forwarded herewith, to which attention is invited.

The available balance on hand will be retained for expenses of mounting guns when they arrive.

This battery was constructed under the immediate supervision of Assistant Engineer R. B. Talfor, from January 26, 1899, to December 2, 1899, and of Supt. W. A. Hinkle from December 3, 1899, to date.

This battery was transferred on March 31, 1900, to the artillery for their care and use, and no further reports on construction will, therefore, be submitted.

Money statement.

July 1, 1899, balance unexpended	$13,544.27
Amount transferred to 15-pounder rapid-fire battery No. 1	1,500.00
	12,044.27
June 30, 1900, amount expended during fiscal year	11,831.91
July 1, 1900, balance unexpended	212.36

Mortar battery No. 2.—This battery is designed for eight 12-inch mortars, and is being constructed by hired labor under an allotment from appropriation for "Gun and Mortar Batteries," act of May 7, 1898. The estimated cost of this battery was $165,000.

Work was begun on this battery September 17, 1898, and the condition of the work at beginning of present fiscal year was as follows: Foundation piles all driven and a timber grillage laid on piles, except those for platforms, which were left until after sand fill had been put up, so that all settlement will have occurred before they are begun; outside plastering on front and end walls half finished, and back walls and gun pits three-fourths finished; damp course at the 9-foot elevation under all magazines and asphalt course over all roofs finished.

During the present fiscal year the sand protection was completed and is ready for soil and Bermuda grass covering. Eight mortars and carriages were received and unloaded.

At close of present fiscal year riprap protection to sheet-piling revetment is being unloaded and placed, 920.74 tons having been unloaded and placed.

The total average settlement is 0.62 foot and the tip to front is 0.43 foot.

The amount expended on this battery to June 30, 1900, was $106,139.76, and was expended as follows:

Broken stone	$27,883.75
Cement	20,803.40
Sharp sand	6,029.11
Revetment sheeting	720.46
Pile and grillage foundation	3,794.99
Lumber, casing, etc	2,108.09
Drain and ventilating pipes	560.92
Doors and light chambers	145.09
I-beams, trolley beams, and hand rails	4,185.00
Anchor bolts, nuts, etc	524.00
Hollow partition tiles	512.50
Damp and asphalt courses	2,418.54
Coal, oil, waste, etc	926.86
Plant	3,399.86
Sand fill	5,932.90
Miscellaneous expenses	424.98
Labor, superintendence, and office expenses	25,769.31
Total amount expended to June 30, 1900	106,139.76

The methods used in the construction of this battery are described in report on 10-inch battery No. 2, Annual Report of the Chief of Engineers for 1899, page 959 et seq.

This work was under the immediate supervision of Supt. S. W. Campbell to January 12, 1900, and of Supt. W. A. Hinkle to date.

Money statement.

July 1, 1899, balance unexpended	$40,525.57
June 30, 1900, amount expended during fiscal year	21,647.36
July 1, 1900, balance unexpended	18,878.21
July 1, 1900, outstanding liabilities	10,867.37
July 1, 1900, balance available	8,010.84

Electric light and power plant.—This plant was designed by Lieut. Harry Burgess, Corps of Engineers, United States Army, and is designed for electric lights and power at 10-inch battery No. 1 and 12-inch mortar battery No. 1. Each plant to consist of an oil engine, generator, lamps, wire guards, key sockets, fuses, switches, storage batteries, insulated conduit, junction and outlet boxes, and all wiring, connections, etc., necessary.

The estimated cost of this plant was $10,000, and it was constructed by contract under an allotment from appropriation for "Gun and Mortar Batteries," act of May 7, 1898. Contract was entered into March 6, 1899, with Young & Cohen, of Galveston, Tex. Contract date of completion was May 31, 1899, but was extended to July 31, 1899.

At the beginning of the present fiscal year the contractor had practically all wiring done, dynamos and engines installed, and all necessary material and articles on hand to complete the work.

Contractors completed installation of plants on July 31, 1899, and after necessary tests same was accepted.

The total cost of these plants was $9,615.14, and may be summarized as follows:

Plant at 10-inch gun battery No. 1.

Installation of plant	$5,480.42	
Miscellaneous expenses	44.34	
Labor and superintendence	174.95	
		5,699.71

Plant at 12-inch mortar battery No. 1.

Installation of plant	$3,704.67	
Miscellaneous expenses	43.90	
Labor and superintendence	166.86	
		3,915.43
Total cost of plants		9,615.14

These power plants were transferred on October 25, 1899, to the artillery for their care and use, and no further reports concerning their installation will therefore be submitted.

This work has been under the immediate supervision of Supt. W. A. Hinkle.

Money statement.

July 1, 1899, balance unexpended		$9,715.39
June 30, 1900, amount expended during fiscal year	$9,330.53	
June 30, 1900, amount deposited with Treasurer of the United States	384.86	
		9,715.39

Contracts in force during the fiscal year.

With Young & Cohen, Galveston, Tex., for electric-light installation. Date of contract, March 6, 1899; date of approval, March 21, 1899; work begun, May 2, 1899; expiration, July 31, 1899.

Preservation and repair of fortifications.—During the fiscal year the following work was done:

At 10-inch battery No. 1 gullies caused by heavy and continued rains during the year in sand and soil protection were repaired. Ammunition hoists and surface drains on slopes were repaired. Doors were so trimmed that they would open and shut easily. Salt cedars were planted around foot of revetment, and Bermuda grass sod was planted on slopes. Tools for use of artillery in running electric light and power plant and caring for the battery were purchased and transferred to the artillery.

At mortar battery No. 1 surface drains on slopes were repaired, Bermuda grass sod was replanted in bare spots and salt cedars were replanted around revetment.

At two 4.7-inch gun emplacements Bermuda grass sod was planted on bare spots, and salt cedars were planted around revetment.

At torpedo casemate gullies in sand protection, caused by rain, were repaired. Slopes where torpedo tracks cross corner were graded and sod was planted. The fence around casemate was repaired, and steps leading to the top were put up.

Semiannual inspections of torpedo materials were made during the year.

At 10-inch battery No. 2 salt cedars were replanted around revetment, east gun was releveled, doors were trimmed and put in order, hatches over steps from lower passage to loading platform were repaired, and leaks and drains were repaired.

At two emplacements for 15-pounder rapid-fire guns, battery No. 2, salt cedars were planted around revetment, and doors and light chamber windows were put in order.

Tools for use in caring for these batteries were purchased and transferred to the artillery.

At two 8-inch gun emplacements doors were repaired and cracks in the parapet were cleaned and filled with plastic gum, stopping leakage.

At three emplacements for 15-pounder rapid-fire guns, the soil covering of sand protection was screened free of gravel, mainland soil was spread over same, and Bermuda grass was planted.

Tools for use in caring for these batteries were purchased and transferred to the artillery.

Money statement.

July 1, 1899, balance unexpended	$3, 295. 06
August 25, 1899, amount allotted	60. 00
January 5, 1900, amount allotted	275. 00
March 1, 1900, amount allotted	120. 00
June 28, 1900, amount allotted	2, 000. 00
	5, 750. 06
June 30, 1900, amount expended during fiscal year	2, 593. 76
July 1, 1900, balance unexpended	3, 156. 30
July 1, 1900, outstanding liabilities	127. 05
July 1, 1900, balance available	3, 029. 25

Emplacements for two 6-inch guns.—Under date of July 10, 1899, a provisional allotment of $5,000 was made from the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, for filling in the site for this emplacement.

During the fiscal year the site was filled in by the U. S. dredge *Gen. C. B. Comstock*. One hundred and twenty-five thousand cubic yards of sand was placed. Sand fences for preventing the cutting of channel through the site during high tides were constructed.

The cost of filling the site may be summarized as follows:

Discharge pipe and rubber sleeves		$843. 00
Subsistence supplies, *Gen. C. B. Comstock*		675. 20
Submarine diving and lighterage		477. 42
Ropes, oil, waste, etc		787. 25
Labor, trestle	$159. 03	
Labor, *Gen. C. B. Comstock*	2, 058. 10	
		2, 217. 13
Total		5, 000. 00

The filling of the site was under the immediate supervision of Capt. G. M. Prendergast, master of U. S. dredge *Gen. C. B. Comstock*, assisted in construction of trestles and other shore work by Supt. W. A. Hinkle.

Money statement.

July 10, 1899, amount allotted	$5, 000. 00
June 30, 1900, amount expended during fiscal year	5, 000. 00

Two 10-inch gun emplacements, battery No. 2.—This battery is designed for two 10-inch guns on disappearing limited-fire carriages, and was constructed by hired labor under an allotment of $110,000 from the appropriation for "National Defense," act of March 9, 1898. The estimated cost of the battery was $115,000.

The condition of the battery at the beginning of the fiscal year was as follows: Emplacements completed and ready to be turned over to the artillery as soon as the guns and carriages were in place. The carriages were on hand, but guns had not yet arrived.

During the fiscal year the guns were received and carriages were assembled and guns were mounted on same.

The total average settlement of this battery is 0.43 foot and the tip to front is 0.14 foot.

This work was under the immediate supervision of Supt. S. W. Campbell.

On October 25, 1899, this battery was transferred to the artillery for their care and use, and no further reports concerning its construction will therefore be submitted.

The total cost of this emplacement was $109,000.

Two 8-inch gun emplacements.—This battery is designed for two 8-inch guns on disappearing limited-fire carriages, and was constructed by hired labor under an allotment of $110,000 from the appropriation for "National Defense," act of March 9, 1898. The estimated cost of the battery was $115,000.

The condition of the battery at the beginning of the present fiscal year was as follows: Emplacements were completed and ready to be turned over to the artillery as soon as guns and carriages were in place. Two 8-inch guns and disappearing limited-fire carriages were on hand and the work of mounting them in progress.

During the fiscal year the work of assembling carriages and mounting guns was completed.

Levels taken at various times show a continued slight settlement until February, 1900. Since that time there has been no settlement shown. The tip of the battery toward the front is 0.62 foot; average total settlement, 1.33 feet.

The unequal settlement of this battery caused a crack at each end between parapet and loading platform through which water entered and flooded rooms and passageways. These cracks were partially filled with a plastic gum, put in hot, of the following proportions: Asphalt 60 per cent, pitch 30 per cent, rosin 10 per cent, worked through still separate and mixed at a uniform temperature in hot mixer. On top of this was cement grouting or plaster, one part Portland cement and one and one-half sharp sand. Where small cracks had formed which allowed water to enter, a V-shaped groove or channel was cut with cold chisels, and then grouting poured in until cracks were filled, and then the channels filled with plaster and smoothed off. It is thought that all leakage has been stopped.

On October 25, 1899, this battery was transferred to the artillery for their care and use, and no further reports concerning its construction will therefore be submitted.

The total cost of this emplacement was $111,000.

This battery was constructed under the immediate supervision of Supt. W. A. Hinkle, from April 8, 1898, to December 31, 1898, and of Assistant Engineer R. B. Talfor, from January 1, 1899, to date of transfer to artillery.

Two 4.7-inch gun emplacements.—This battery is designed for two

4.7-inch rapid-fire guns on pedestal mounts for all-round fire, and was constructed by hired labor under an allotment of $41,000 from the appropriation for "National Defense," act of March 9, 1898. The estimated cost of the battery complete was $50,000.

At the beginning of the present fiscal year this emplacement was complete, with guns mounted and ready to be turned over to the artillery.

This battery has apparently stopped settling. Total average settlement 0.45 foot, with 0.02 foot tip to front, except near the traverse, where the tip is 0.16 foot to rear and a longitudinal tip of 0.03 foot toward traverse.

This work was constructed under the immediate supervision of Inspector Abm. Cross from April 8, 1898, to December 31, 1898, and of Supt. W. A. Hinkle from January 1, 1899, to date of transfer to the artillery.

On October 25, 1899, this battery was transferred to the artillery for their care and use, and no further reports concerning its construction will therefore be submitted.

The total cost of this battery was $41,000.

Unloading and mounting 10-inch and 8-inch guns and carriages.—At two 10-inch gun emplacements, battery No. 2, at the beginning of the present fiscal year the two carriages were on hand. The two guns were received August 16, 1899. On August 31, 1899, the carriages had been assembled and guns mounted on same.

At two 8-inch gun emplacements at the beginning of the present fiscal year the guns and carriages were on hand and the work of mounting them in progress.

On July 31, 1899, the carriages had been assembled and guns mounted on same. The cost of unloading and mounting these guns and carriages may be summarized as follows:

10-inch guns and carriages.

Hardware, tools, etc	$51.15
Lumber	74.66
Switching charges	34.00
Labor and superintendence	1,654.21
Total cost of assembling and mounting guns	1,814.02

8-inch guns and carriages.

Hardware, tools, etc	$51.64
Switching charges	18.00
Subsistence supplies	230.44
Labor and superintendence	885.90
Total cost of assembling and mounting	1,185.98

This work was under the immediate supervision of Supts. W. A. Hinkle and S. W. Campbell.

Money statement.

July 1, 1899, balance unexpended	$3,000.00
June 30, 1900, amount expended during fiscal year	3,000.00

Cable tank.—This is a concrete tank 20 by 40 feet, having a wooden building over same, and was constructed by hired labor under an allotment from appropriation for "Torpedoes for Harbor Defense," act of May 7, 1898. The estimated cost of the tank was $3,000.

Work on this tank was begun February 17, 1899, and at the beginning of the present fiscal year the work was practically completed, except battens and superstructure for traveling crane.

During the present fiscal year this tank has been completed and all cable stored in same.

The cost of this tank may be summarized as follows:

Cement	$685.74
Hardware, etc	71.52
Roofing	214.01
Lumber	167.48
Labor and superintendence	1,861.25
Total cost of tank	3,000.00

This work was under the immediate supervision of Supt. W. A. Hinkle.

Money statement.

July 1, 1899, balance unexpended	$362.78
June 30, 1900, amount expended during fiscal year	362.78

Torpedo storehouse.—This is a wooden building, the interior dimensions being 72 by 25 by 14 feet, and was constructed by hired labor under an allotment from appropriation for "Torpedoes for Harbor Defense," act of May 7, 1898. The estimated cost of this storehouse was $2,000.

Work was begun on this storehouse April 25, 1899, and at the beginning of the present fiscal year was practically completed except the hanging of doors and some minor inside work. Most of the torpedoes and anchors and other submarine-mining material had been stored.

During the present fiscal year this storehouse has been completed, and all torpedoes, anchors, and other submarine-mining material have been stored in same.

The cost of this storehouse may be summarized as follows:

Lumber	$421.23
Guttering	6.81
Hardware, etc	117.44
Roofing	142.26
Labor and superintendence	1,312.26
Total cost of building	2,000.00

This work has been under the immediate supervision of Supt. W. A. Hinkle.

Money statement.

July 1, 1899, balance unexpended	$236.14
June 30, 1900, amount expended during fiscal year	236.14

System of tracks, etc., for submarine-mining service.—This system of tracks was constructed by hired labor under an allotment from appropriation for "Torpedoes for Harbor Defense," act of March 3, 1899, and consists of a standard-gauge railway track on trestle connected with the United States south jetty railway at Station 68+40 and extending to harbor lines at coal bin, a distance of 850 feet. Three spur tracks connect with this main track, one 193 feet long leading to cable tank, one 135.5 feet long leading to gallery of torpedo storehouse, and one 108.5 feet long leading into torpedo storehouse.

This system of tracks greatly facilitates the handling of torpedo ma-'al, allowing same to be delivered to storehouse and cable tanks by either boat or cars; also in time of war to transfer material by hand car to and from the buildings and the planting tug or barge.

The estimated cost of this system of tracks was $5,000, which also covered expenses of removing submarine cable stored in the water off the south jetty and placing same in cable tank.

Work was commenced on December 9, 1899, and was completed April 5, 1900.

The cost of this work may be summarized as follows:

Piling	$1,166.50
Screw bolts	80.00
Switch stands and frogs	45.00
Hardware, tools, etc	420.61
Labor and superintendence	3,211.40
Total	4,923.51

The available balance will be retained for expenses of removing and storing cable still remaining in water off south jetty.

This work was under the immediate supervision of Supt. W. A. Hinkle.

Money statement.

October 18, 1899, amount allotted	$5,000.00
June 30, 1900, amount expended during fiscal year	4,923.51
July 1, 1900, balance unexpended and available	76.49

REPORT OF MR. W. A. HINKLE, SUPERINTENDENT.

Two emplacements for 15-pounder rapid-fire guns, battery No. 1.—Condition of the work July 1, 1899: Foundation piles, lumber, ventilating pipes, partition tiles, I-beams, and hand-rail material received and stored; 1,300 feet of trestle constructed and pipe laid on same for filling battery site.

Progress of the work: On July 12, 1899, the dredge *Gen. C. B. Comstock* began filling site; completed same August 15, 1899, having placed 75,000 cubic yards of sand. As this boat is a deep-draft vessel, it was necessary to build a trestle of timber some 1,300 feet long to support the discharge pipe. This trestle had a grade of 4 inches in 100 feet. There was no difficulty in delivering sand 2,200 feet from the dredge.

Pile driver and engines received from another locality August 21. Same set up and commenced driving sheet piles for revetment on the 24th, and completed same September 6, 1899. Total piles driven, 364. The sheet piles were driven first on account of approach of storm season, to protect plant. Cost of same per linear foot of revetment, $0.316.

Commenced driving foundation piles September 6, finished same on September 11, 1899, having driven 145 piles. Penetration, 20 feet. Cost per pile driven, $1.38; labor per linear foot, $0.073.

Actual work of placing concrete was begun September 25 and completed October 26, 1899, 741 cubic yards having been placed. In this battery there was no so-called granolithic work, though practically the concrete in top finish and floors is as good and at a much less cost. When the concrete foundation was within about one foot of floor level the rooms were laid off and defined by suitable timbers, the top edge representing the floor. The front of rooms was raised 0.3 foot higher than the rear to allow for settlement and drainage. While this was being done concrete was being put in at other places, and as soon as timbers were in position concrete was put in level with the top, the last few inches being made richer with cement. The concrete was made thin enough to quake and leveled off with a heavy straightedge. Where points of the larger rock showed through they were tamped below the surface. When the surface was properly trued-up planks were laid across and finishers troweled the surface over the whole area, dusting on neat cement to get a finish. As soon as this was done the floor was laid off in blocks and marked with a marker, giving appearance of having been put in in blocks. This work was so timed that the floors were finished near the quitting time for the day. The ceilings have the same pitch as the floors, so that there is the same headroom all over. The only extra labor involved in this manner of finishing floors was the time of putting timbers in place and finishing off surface.

All concrete was mixed by manual labor with shovels on mixing boards.

When setting studding for the casing of outside walls the studding was cut about 2½ feet above the height the walls were intended to be. As the battery is less than 30 feet in width, stringers 6 inches by 14 inches by 30 feet were placed across, about 5 feet apart, and 3 mixing boards 10 by 20 feet were placed on these. The derrick was placed on a platform built to the same height as the mixing boards. The boom of the derrick described a circle, passing over the sand and rock bins, which were in front of the battery site. A car of cement was placed contiguous to the sand bin, and when a skip was loaded with sand a barrel of cement was placed on same and lifted to the mixing board. The middle mixing board was filled first, and while this was being mixed and thrown to place one of the other boards was being filled. The force of laborers was so regulated that no time was lost waiting on mixing boards. There are several advantages in having the mixing boards on top of the battery. The use of wheelbarrows to put concrete in place is avoided; the labor of spreading and tamping is greatly reduced, especially near the bottom; in warm weather the men get the advantage of the breeze; and the foreman or overseer, being with the mixing gang, has all of his men under surveillance. The water for mixing purposes was forced up with a steam pump.

The top finish of concrete was similar to the floors. When the concrete was within about 2½ feet of proper elevation, the forms for blocks were put in, making the blocks 6 feet wide and running the whole distance across from front to rear solid. The first series of blocks spread out at the bottom somewhat wider than the forms. When up to the top of forms the top was finished same as described for the floors. The blocks were completed alternately, beginning at one end and working through to the other end of battery. The force on this work was so regulated that when the last block was finished the first one had been finished two days and was hard enough to remove forms and finish intermediate blocks. The advantage of finishing the top in blocks 2 feet or more thick is that there are no hollow places in the top to finish, no separation at joints and no leaks, and the bond on the more or less dry concrete below is better.

Damp course under floors containing 624 square feet was put down September 30, and the asphalt course over magazines and rooms containing 614.5 square feet was put down October 16, 1899.

Cost of concrete, material and labor placing, $6.92 per yard.

The three emplacements for 15-pounder rapid-fire guns had top finish similar to this battery, and the plant the same.

These two batteries are the only ones here which have no hollow places in top finish.

On November 17 commenced placing riprap protection; completed same December 2, 1899, having placed 660 cubic yards. Cost per cubic yard in place, $1.

Commenced placing sand protection November 15, 1899, and completed same January 11, 1900. This was done by hired labor, as we had most of the plant on hand and as there were but about 3,564 cubic yards to be placed. The plant for this work was two seven-eighths-inch steel-wire hoisting ropes stretched from masthead of derrick in opposite directions some 500 feet to anchors embedded in the sand. On these were placed trolleys made of one-half-inch iron for the shell, between which two 5-inch sheaves were secured, grooved to fit the wire trolley. From a hook secured to the trolley was suspended a wooden skip hoisting about 1 yard of sand. Wire hoisting ropes were run from the drums of hoisting engine through lead blocks at masthead and secured to trolley. When a skip was filled with sand it was hoisted up along the trolley wire until where desired, then tripped and allowed to run back by gravity.

The sand was put in place at a less figure than could have been done by contract. Cost per yard in place, $0.171.

The soil was loaded from cars into skips and dumped on top of battery, and then distributed with wheelbarrows. Oats were sown on surface of sand and Bermuda grass roots distributed in the same way, then soil put on top 6 inches thick. The oats soon came through soil and helped hold soil to place and prevent washing from rains. The oats have died out and there is a good spread of Bermuda grass. Cost per cubic yard in place, $1.59.

Two 4.7-inch gun emplacements.—Condition of the work July 1, 1899: Battery complete, with guns mounted and ready to be turned over to the artillery.

No work done on this battery during the present fiscal year.

Emplacements for 10-inch guns, battery No. 1.—Condition of the work July 1, 1899: Battery complete, with guns mounted and ready to be turned over to the artillery.

No work was done on this battery during the fiscal year.

Power house, 10-inch battery No. 1.—Condition of the work July 1, 1899: This building completed and ready for the installation of plant.

No work done on this building during the year.

Mortar battery No. 1.—Condition of the work July 1, 1899: Battery complete, with mortar raised from 6.4 feet to 8.1 feet above mean low tide. The drainage system established last year has worked satisfactorily during the present year.

This battery shows slight settlement during the year. Pit A has settled 0.07 foot and Pit B 0.12 foot, showing a slight tip from Pit A to Pit B.

No work done on this battery during the fiscal year.

Emplacements for 6-inch guns.—Progress of the work: On August 8, 1899, a trestle for supporting discharge pipe from site of two emplacements for 15-pounder rapid-fire guns, battery No. 1, a distance of about 800 feet to site for these emplacements, was commenced and completed August 15, 1899, with pipe placed on same.

The dredge *Gen. C. B. Comstock* commenced filling site August 16 and completed same September 4, 1899, having placed 125,000 cubic yards of sand. Sand fences for preventing the cutting of channels through site have been constructed and salt cedars planted along same.

Electric light and power plant.—Progress of the work: During the month of July all wires were put up, machinery put in place, and plant reported ready for testing August 1. Testing of plant was begun at 12.10 p. m. August 3, and continued day and night until 12 m. August 5, 1899. Everything worked in a satisfactory manner. No sparks at the brushes of the dynamos were observed at any time, and the engines worked smoothly at from 180 to 200 revolutions.

Cable tank.—Condition of the work July 1, 1899: The tank and house over same were complete, except battens and superstructure for traveling crane. All cable, except about 6 miles in water, stored in tank.

The tank was originally filled with salt water. This was run out in order to place recovered cable and is now filled with fresh water. Connections are so made as to fill tank with Alta Loma water from the city waterworks mains.

Progress of the work: The house over tank was completed in July, 1899, and painted; superstructure for traveling crane erected.

About 6 miles of cable were recovered from where laid in channel and stored in tank.

About 300 feet, in two pieces, is still in water in the vicinity of Station 141, south jetty. This was fouled by the dredge *Comstock* and cut, and will have to be grappled for.

Torpedo storehouse.—Condition of the work July 1, 1899: Building complete, except hanging doors and some minor inside details. Most of the torpedo material had been stored.

Progress of the work: Building completed, with doors hung, shelving and racks put up, and building painted. All mining material stored in same. Railroad track laid inside of house and on gallery.

System of tracks, etc., for submarine-mining defense.—Progress of the work: Work was commenced December 10, 1899, and completed April 30, 1900, and consists of one spur trestle, beginning at Station 69 + 40 on jetty track and running to harbor line at coal bin, a distance of 850 feet. Three spur trestles with track laid on same have been driven from this, viz, one to cable tank, 193 feet; one to gallery of torpedo storehouse, 135 feet, and one to torpedo storehouse, 108.5 feet. These tracks are all standard gauge.

A roadway 16 feet wide for wagons constructed from casemate to harbor line. Access to roadway is had by an incline at northeast corner of casemate, and a planked crossing over jetty track. There is a hand rail on each side of roadway from incline to wharf.

There is also an incline at harbor line by which teams can be loaded or unloaded on boats.

Two 8-inch gun emplacements.—On December 3, 1899, I succeeded Capt. R. B. Talfor, assistant engineer in charge of works at this point, and found the batteries complete.

Condition of work July 1, 1899: Battery complete and ready to be turned over to the artillery.

The guns were mounted during the month of July, 1899. No other work was done during the fiscal year.

Three emplacements for 15-pounder rapid-fire guns.—Condition of the work July 1, 1899: Sheet piles driven, foundation piles all driven and grillage placed on same. Concrete work was at approximately the 18-foot elevation, casing erected to the full height.

Progress of the work: Concrete work was completed July 21; total cubic yards placed, 1,109. Casing removed and plastering commenced July 31; finished same September 8, 1899. Contractor commenced placing sand protection August 15; completed same September 18, 1899, having placed 4,000 cubic yards of sand. Contractor for placing riprap protection began work October 31; finished same November 14, 1899, having placed 670.5 cubic yards.

The contractor began the delivery of soil on October 23; finished same October 26, 1899, having placed 115.12 cubic yards.

These emplacements were completed and ready to be turned over to the artillery November 25, 1899.

Guns and carriages have not yet arrived.

Two 10-inch gun emplacements, battery No. 2.—On January 12, 1900, I succeeded Supt. S. W. Campbell, and found the works completed.

Condition of the work July 1, 1899: Battery completed and ready for reception of guns.

Guns were mounted complete during the month of August, 1899, and the battery ready to turn over to the artillery.

Two emplacements for 15-pounder rapid-fire guns, battery No. 2.—Condition of the work July 1, 1899: Battery complete except concrete work for gun castings and blast surfaces, and sand and riprap protection.

Progress of the work: Sand fill completed December 31, 1899, containing 3,433.36 cubic yards; soil and Bermuda grass sod placed during the month of January, 1900; 207.07 cubic yards placed. Riprap protection is being placed, 324.57 tons having been placed to date.

Probable operations for next year: Completion of riprap protection, assembling and mounting guns and carriages when they arrive, and putting in blast surfaces.

Mortar battery No. 2.—Condition of the work July 1, 1899: Foundation piles all driven, sheet piles all driven; concrete work all completed except floor pavements, observing stations, and gun platforms, which were left until after sand fill has been put up; outside plastering finished, and inside finished to within 1 foot of floor line; hand rails, ventilating pipes, and trolley rails are all in place.

Progress of the work: No concrete placed during the year; contractor for sand fill began pumping sand September 29, 1899, and completed same June 18, 1900, having placed 50,245.37 cubic yards.

Riprap protection is being placed on outside of sheet piling; 920.74 tons placed to date. Mortars and carriages have been received and unloaded. The slopes are now being graded for soil and Bermuda grass.

The contractor's plant consists of a barge or flatboat with house to protect machinery, one No. 8 Morris pump, 8-inch suction and 8-inch discharge, one 35-horsepower boiler, and 25-horsepower engine running pump at 285 to 425 revolutions per minute.

The barge with machinery is placed in a bayou inside the reservation some 300 to 500 feet from the battery, requiring about 1,000 feet of pipe from pump to end of discharge, the discharge end being 40.5 feet above mean low tide or 39.5 feet above the water surface at barge. The water in the bayou varies from 1 to 2 feet. The pump is 2 feet above the water surface and therefore forces the material to an elevation of 37.5 feet, the output at this elevation being nearly if not quite as much as at the lower elevation.

The contractor for his own convenience used common hay, most of which has been damaged by fire, to hold sand to proper slope. An embankment of hay and sand would be made about 1½ to 2 feet high, and while the sand was being pumped to this elevation on one-half of the battery the other half was being prepared. In future work, I would suggest that hay be specified and kept to line of proper slope, as it serves the twofold purpose of keeping the sand and soil in place and prevents gullying from rains and gives the necessary air which Bermuda grass requires.

Probable operations for next year: Finishing concrete work of floors, pavements, and gun platforms, assembling and mounting mortars, placing soil and sod, and finishing riprap protection.

Preservation and repair of fortifications.—Salt cedars have been planted around revetment at one of the sites, sod planted on all bare spots, surface drains on slopes repaired on batteries where necessary.

Eight-inch gun emplacement: Doors have been repaired and cracks in parapet filled with plastic gum and gun releveled.

Emplacements for 15-pounder rapid-fire guns: Soil on superior slope has been screened free of gravel and two cars of soil from mainland have been spread on slopes, with Bermuda grass roots planted.

Salt cedars have been planted around revetment at site of 10-inch battery No. 2; also China tree seeds planted in rear of batteries. East gun releveled at 10-inch gun emplacement, doors trimmed, hatches over passageways repaired, cracks, leaks, and drains repaired where necessary.

Unloading and mounting guns.—At 8-inch gun battery. Progress of the work: Work of assembling and mounting guns was begun July 1, and guns were mounted complete · 31, 1899.

A detailed report of this work has already been made.

At 10-inch gun battery No. 2. Progress of the work: Work of assembling carriages was begun July 28 and completed August 17, 1899. The guns were received August 16, unloaded, and mounted complete August 31, 1899.

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3 T.

DEFENSES OF LAKE PORTS.

Officer in charge of defenses of Detroit River, Lieut. Col. Garrett J. Lydecker, Corps of Engineers. Officer in charge of defenses of Lake Champlain, Col. John W. Barlow, Corps of Engineers. Officers in charge of other lake ports in New York, Capt. Graham D. Fitch, Corps of Engineers, until February 13, 1900, and since April 26, 1900, and Maj. Thomas W. Symons, Corps of Engineers, from February 13 to April 26, 1900; Division Engineer, Col. George L. Gillespie, Corps of Engineers.

Fort Wayne, Michigan.—Nothing was done to this fortification during the year, nor were any expenditures made on account of it.

An allotment of $150 was made June 9, 1899, which is the amount now available, and will supply all that is needed for the little work that may be required to preserve most of its perishable parts, such as painting or repairing roofs over entrances to casemates, and doors of casemates, magazine, and sally port. But the timber revetment on three sides of the rampart is now 40 years old, or more, is in a very bad state of decay, and altogether a most unsightly and unserviceable affair; for this reason it is highly desirable that they be removed so as to leave the rampart with interior earthen slopes. This would place these three sides in the same condition as the fourth side was placed several years ago. It would probably cost about $900 to make this change, and an allotment of that amount for this purpose is recommended.

Fort Niagara, New York.—In September, 1899, the concrete breakwater at the northwest corner of the fort was repaired.

The bank was watched during the fall of 1899 and winter of 1899–1900.

In April, 1900, a part of the crest of the bank, graded in 1897, which was found to have settled and broken away, was raised to the height of the rest of the bank and a drain laid to carry off the surface water, and in May and June, 1900, 7,157 square yards of the bank were sodded.

The expenditures for the year have been:

For caring for and repairing river bank	$572.01
For repairing concrete breakwater	9.07
For engineering, office, and incidental expenses	87.50
Total	668.58

Fort Montgomery, New York.—Nothing was done during the year except to repair the fence surrounding the reservation.

A fort keeper was employed in looking after the fort, an ordnance sergeant having charge of the ordnance.

The amount expended during the year was $607.50, which was applied as follows:

To services of fort keeper	$540.00
To inspection	13.40
To repairing fence	54.10

3 U.

DEFENSES OF SAN DIEGO, CAL.

Officer in charge, Capt. James J. Meyler, Corps of Engineers; Division Engineer, Col. S. M. Mansfield, Corps of Engineers.

Ten-inch gun battery.—The fourth emplacement, No. 1, of this battery, which was under construction by hired labor at the beginning of the year, was then practically completed. The other three emplacements, Nos. 4, 3, and 2, had previously been built by contract, and the guns and carriages had been mounted therein by the artillery garrison. During the year just closed a wing wall was constructed at No. 1, the earthen parapet was brought to the proper slopes, the terreplein was graded, the roadway and main sewer in rear of the battery were completed, and the base ring was set. The gun and carriage were mounted by the troops. In ammunition lifts of Nos. 2, 3, and 4 heavier bracket hangers were put in place of the light ones originally installed, and in the wall between powder and shell room of each emplacement a hole 2 feet square was cut for the purpose of increasing the circulation of air in those rooms, and especially of correcting the dampness due to condensation in the powder rooms. These three earlier emplacements were constructed without placing waterproof courses over the ceilings of rooms, and, as a result, during the past year dampness due to seepage caused much trouble, especially in the powder rooms and traverse galleries. In consequence, though the four emplacements have been turned over to the charge of the artillery commander, it yet remains for the Engineer Department to adopt proper measures for keeping these rooms dry at all times. The boiled-oil remedy, which was so successfully applied on the fortification works at the mouth of the Columbia River, was tried in this battery last winter. During the next two rain storms there was little or no dampness to be found in rooms and passages, but after the last rain of the season, which was a heavy one for this climate, some of the rooms were found as damp as ever. Other remedies are now being experimented with, and it is expected that before the next rainy season sets in this evil will have been done away with.

Money statements.

ONE 10-INCH GUN EMPLACEMENT (NO. 2).

July 1, 1899, balance unexpended	$52.11
June 30, 1900, amount expended during fiscal year	37.09
July 1, 1900, amount unexpended and available	15.02

ONE 10-INCH GUN EMPLACEMENT (NO. 1).

July 1, 1899, balance unexpended	$4,431.32
November 1, 1899, amount allotted	1,100.00
	5,531.32
June 30, 1900, amount expended during fiscal year	5,424.37
July 1, 1900, amount unexpended and available	106.95

Torpedo casemate.—In the latter part of December, 1898, an allotment of $2,200 was made for additions and changes in the mining casemate, experience during the Spanish war having shown that the existing casemate was too small to contain all the apparatus necessary to operate the mine system of this harbor. An additional room was constructed for an engine room, and at the beginning of the fiscal year the concrete work was almost completed. During July, August, and September the remaining concrete work was finished. The doors and windows were put in and iron shutters were hung in place. The outside grading was completed, the electric-light strip, guard railing, and fence about the entrance and light well were put in place, and all painting and whitewashing were completed. In February and March of this year a storage-battery case was installed and painted, thus completing all work under this allotment.

The work of construction, which was done by hired labor, was carried on with that of the gun emplacements and other buildings, the working force being used to the best advantage on any or all of the works, as circumstances would dictate.

Money statement.

July 1, 1899, balance unexpended	$1,670.70
June 30, 1900, amount expended during fiscal year	1,652.33
July 1, 1900, balance unexpended	18.37
July 1, 1900, outstanding liabilities	.54
July 1, 1900, balance available	17.83

Torpedo storehouse.—At the beginning of the year work on this building had practically been completed, and torpedo material had been stored therein for several months. During this year a small wharf was built at the water's edge, about 150 feet from the storehouse, and tramways were laid from this wharf to the entrances of both the storehouse and the cable tank. Both of these buildings are located at the north end of the Government reservation, about 2 miles from the gun batteries. The work on the wharf and tramways was done by hired labor, the construction being carried on coincidently with the other works, resulting in a saving in the labor item of all the works concerned.

Money statement.

July 1, 1899, balance unexpended	$556.18
June 30, 1900, amount expended during fiscal year	537.52
July 1, 1900, balance unexpended and available	18.66

Fifteen-pounder rapid-fire battery.—At the beginning of the fiscal year the concrete work in this battery had reached the ceilings of the rooms. The remaining concrete was soon put in place, excepting that of one small apron and the two gun platforms. The detail work in the battery was then finished, and the grounds about it have since been graded. The battery is now completed, with the exception of the two gun platforms, which are still awaiting the arrival of the well-linings for the gun mounts, so that the castings can be solidly embedded in the concrete.

Money statement.

July 1, 1899, balance unexpended	$8,297.51
June 30, 1900, amount expended during fiscal year	7,317.62
July 1, 1900, balance unexpended and available	979.89

Five-inch rapid-fire battery.—Under date of July 6, 1899, the Department allotted $15,000 for the construction of two emplacements for

5-inch rapid-fire guns, and under date of January 17, 1900, an additional allotment of $3,270 was made for the same work. All work was done by hired labor, with the exception of the excavation and back filling, which were done by contract. The contractor began excavating on August 21, 1899, and on September 28 he had finished his work as far as he could go until after the concrete was put in place. The remaining earthwork, consisting of digging trenches, sewers, and gun wells, and bringing surfaces to exact slopes, was done by hired labor. The concrete work, which was shortly afterwards begun, was practically finished in December. The doors were then made and hung, the two bridges were put in place, and the drainage system completed, and water pipes were laid from the 10-inch battery to three faucets in this battery. In the latter part of January the contractor completed all earthwork and grading. In February and March the interior of the battery was whitewashed, and outside walls were covered with a cement wash, the hand railing and iron ladder were put in place, mouthpieces were put on the speaking tubes, all woodwork and ironwork were painted, macadam was laid, and other detail work was completed, and plant, tools, and surplus lumber were hauled away and properly stored. Like the fifteen-pounder battery, this battery is now completed, with the exception of its gun platforms, which will have to await the arrival of the well-linings, so that they may be built up solidly in the concrete.

In the construction of this battery, and as far as possible in all other fortification work at this locality during the year, use was made of the plant with which emplacement No. 1 of the the 10-inch battery was constructed, a description of which is to be found on page 976, Report of the Chief of Engineers, United States Army, for 1899.

Money statement.

July 6, 1899, amount allotted	$15,000.00
January 17, 1900, amount allotted	3,270.00
	18,270.00
June 30, 1900, amount expended during fiscal year	17,931.23
July 1, 1900, balance unexpended and available	338.77

Battery commander's station.—Plans and estimates for battery commander's station having been submitted under Department instructions, an allotment was made by Department indorsement of March 3, 1900. Excavation and grading were begun during March, and at the end of May the concrete walls were practically completed, and all other detail work finished as far as possible, awaiting the arrival of the iron and steel roof, shutters, etc. This iron and steel work arrived during June, and at the close of the year was being put in place. It is contemplated that in about one month this structure will be completed. All work on this building was done by hired labor. The concrete materials, lumber, iron, water, etc., were hauled to the site of the work from a point about 2 miles distant, over steep grades and poor roadway.

Money statement.

March 3, 1900, amount allotted	$2,500.00
June 30, 1900, amount expended during fiscal year	888.08
July 1, 1900, balance unexpended	1,611.92
July 1, 1900, outstanding liabilities	799.00
July 1, 1900, balance available	812.92

Preservation and repair of fortifications.—During the year the keeper was employed in the care of fortification works still in the charge of the Engineer Department, and of boats, buildings, fences, board walks, and grounds of a portion of the reservation. He has repaired and painted the old freight barge and the small boats, and he has been kept busily engaged in looking after tools and other property belonging to the Government, and in assisting in various ways in construction work about the batteries.

At the torpedo storehouse and cable tank an additional keeper or watchman was employed in looking after these two buildings and the materials stored therein, and in caring for the latter, keeping them in proper condition by cleaning, oiling, and painting. During the year all electrical instruments and the transformer were packed in hermetically sealed boxes, in accordance with the general instructions, and the loaded compound plugs, which were used in the torpedoes during the Spanish war, were all destroyed.

Money statements.

July 1, 1899, balance unexpended	$7.15
June 9, 1899, amount allotted	1,440.00
	1,447.15
June 30, 1900, amount expended during fiscal year	1,446.55
July 1, 1900, balance unexpended and available	.60

CARE OF TORPEDO MATERIAL.

June 24, 1899, amount allotted	$100.00
June 30, 1900, amount expended during fiscal year	100.00

Other work.—Under instructions received from the Department during the latter part of the fiscal year, plans and estimates were being prepared for the construction of two emplacements for 15-pounder rapid-fire guns.

All of the above work during the year was under the immediate supervision of Assistant Engineer D. E. Hughes, whose duties have been well and ably performed. His report, which is appended herewith, and to which attention is respectfully invited, gives much interesting detail.

REPORT OF MR. D. E. HUGHES, ASSISTANT ENGINEER.

Ten-inch battery.—No. 1, the last of the four emplacements, was nearly completed a year ago. Since then the carpenter work was finished; painting done; a wing wall built; back fill brought to grade; base ring set; the derricks, engines, mixer plant, etc., moved away; some of the sewer lowered, and the roadway behind the whole battery cut down to give a continuous fall back to a single gutter on its far side. It remains to alter the reach of chain blocks and to provide a cover for a sump.

The base ring was leveled from the center. The bubble tube (with telescope attached) of a Y-level was tied on two saddle blocks on a 2 by 4 inch scantling 8 feet long, having one end on the ring and the other pivotally supported over a temporary center post in the well. A three-eighths inch dowel in the center post projected up through a one-half inch hole in the 2 by 4 inch. A wood screw in a bridge piece nailed over the one-half inch hole, projected down into a center-punch mark in the top of the dowel. The combination gave a high support (for stability); freedom of rotation; a fixed point of reference, and, by working the screw, easy means of adjustment, though the last, since distances were equal, was not a necessity. Two laborers in three hours on a cloudy day proved that this ring was so truly made that the highest and lowest points could be made to differ less than one one-hundredth of an inch. The level used was perceptibly affected by differences much smaller than that, even down to one five-hundredth of an inch. After leveling, the upper diameters were found to be equal, no elliptical dishing, and the adjustment by steel wedges under the inner rim was not required. Nuts on anchor bolts were then turned down just to a bearing, dams put in, and grout poured under a small head to better insure complete filling. A month later the ring was as level as before, but the nuts were much tighter, and all the leveling screws were an eighth of a turn above their bearing plates. The cement had swelled a little. The artillery mounted the gun.

In emplacements 2, 3, and 4 the elevator brackets having proved too weak were replaced by heavier ones, and for further security additional supports were given them. With a view to improving circulation of air in the powder rooms and shell rooms, 2-foot square holes were cut through the far upper corner of the 4-foot walls between them. This incidentally gave opportunity to compare broken stone and gravel in concrete. The results, though hardly conclusive, were not unfavorable to gravel. These three oldest emplacements have no waterproof course inside the concrete over the ceilings. The deep scores by which the trowel-finished top had been cut into small squares in imitation of sidewalk to mask flaws and other narrow cracks—some due to unequal settlement, but most of them from shrinkage—permitted much water to reach the more porous mass below and infiltrate through into the rooms. The boiled linseed-oil cure was first prescribed, but after pouring three gallons through a pinched-up funnel into a short length of one small crack it was decided not to saturate the whole mass with the freely flowing oil, which could evaporate and thicken only where exposed, and which might in time go clear through and be very objectionable.

Then it was directed to pour thin grout first, which was done, and over one area the grout while still soft was scratched out and oil poured on top. All behaved perfectly during the next two rains, and expectations ran high, but a third storm after a hotter spell made further experiments in order. Asphalt dissolved in naphtha was put in one crack. It adheres perfectly, but every pinching drives down some that will not return, and lowers the top. Perhaps after a few repetitions of this treatment the material will paint both walls down to a level where it can remain without being much affected by temperature changes above, and thus make the crack hold water. To close the cracks at the surface one of two courses seems to be required, either (1) to pour on a cold day, when cracks are widest, a material like sulphur that will promptly assume sufficient strength to withstand the force of expansion and compel internal thrust like that in continuous rails, or (2) to employ an adhesive and yielding material, like some preparations of asphalt, in a V-shaped groove so wide that expansion and contraction of wider areas concentrated in them will not destroy its integrity. Of course, as a last resort, slovenly patches can be put over the cracks, or the whole area can be covered with a roofing material. Other emplacements here prove that with us condensation is inappreciable if the concrete is otherwise dry. It, when dry, is a rather poor conductor of heat, and all it wants is a thin, impervious coat to keep out the first installment of water that the air may offer.

Artificial ventilation is of small requirement here if waters of infiltration are kept away. The engine room in No. 2, having earth over its roof, which probably prevented checking, has always been perfectly dry. At No. 1 the ceilings showed no signs of dampness, but after a heavy rain there were several wet spots on the walls, especially in the relocation room, mostly up near the top.

Fifteen-pounder rapid-fire battery.—This battery was built about up to ceilings of rooms at the close of June, 1899. It was soon finished, except a small apron, and gun platforms which are still waiting for castings. A part of the foundation is new-made ground of varying depths, which caused unequal settlement and some cracking, even before the work was finished. Settlement has now ceased. There are some shrinkage cracks besides. Waterproofing was put over the rooms. Last winter the ceilings kept dry, but there were a few damp spots on the walls.

Five-inch rapid-fire battery.—This battery and its roadway now running down grade to it are in a side-hill cut about 14 feet deep on one side and over 40 feet on the other. The plow and scraper work begun in August was done by contract. Excavating rooms, gun wells, trenches, and outlet sewer tunnel was done by day labor. Some very hard adobe as well as some cemented cobble could hardly be picked at all. It was undermined and split down with gads. Tiling was laid around just outside the magazines and bombproof in trenches back filled with coarse gravel and covered with straw. In the second, 6 inches of concrete around three sides of magazines, 2 feet from the inside, trenches were formed, over which were placed the hollow tiling to make the "air spaces." These tiles, put in as the work progressed, reach about a foot above the ceilings. They were capped with three-sided square tiles making, over the vertical cells, continuous horizontal passages, which, as well as the trenches below, were led to gratings in outer face of walls. Form lumber for ceilings and outside exposed walls, where 3 inches of facing was used, was 1 by 4 inch tongued and grooved pine flooring. I-beams were settled down in thin course of mortar to within 1½ or 2 inches of the ceilings. Above the I-beams over the magazines trowel-finished roofs were made, with gentle pitch three ways, extending to far side, upper corner of air spaces. On these were laid three courses of tarred roofing paper and asphalt, the sheets in each course running horizontally and lapping like shingles. Over the bombproof, where there is no air space, the roof course is thinner and slopes only one way. It extends clear through the wall on one side and reaches to within 18 inches of the other three. The back walls were all plastered and covered with paraffin paint, also the latrine roof and so much of the bombproof as is covered with earth. The storeroom over the bombproof and under the observing station has no special protection except the trowel-finished floor of the latter, which will remain impervious unless season checks occur. It held an inch of water for days and did not leak a drop. The top finish and cement wash on walls were darkened with lampblack. The floors were left quite smooth, but steps, gun platforms, and top were roughened a little to prevent slipping. No jointing was done except between the walls and the aprons which were built later, after back filling. Speaking tubes are 1½-inch pipe. Ordinary elbows make some of the turns. Care was taken to avoid low places; they all end with couplings flush with the wall. Into these, pine plugs, well soaked in oil, were screwed, then sawed off and bored true for the 1-inch nickel mouthpieces, which were smeared with white lead and forced in. The boss covers the plug. Hydrants were placed near each gun platform and one in a corner in the roadway. Cement drip basins, with outlet drains, were placed under them. Inside walls were plastered, one coat with cement and sand and a little lime added to make it work better. Some rooms were washed with alabastine, the rest with a whitewash of lime and a little cement and tallow. They still look much alike, and both are satisfactory. There has been no trace of dampness yet. The work was made a monolith as far as practicable. About two months after it was completed a few season checks in the top began to show, which will probably increase during this first summer.

The concrete was composed of about 1 part of Germania Portland cement, measured loose; 3 parts of fine beach sand, and 8 parts of unscreened 2-inch crushed hard cobbles. The materials were hauled, as described in last year's report, to the cubical mixer near the 10-inch battery. Thence by cable and stationary engine on the hill it was taken in a bottom-opening hopper car up a steep grade and onto a trestle crossing the pit 7 feet above the level of parapets. The car was dumped slowly, to avoid shock, through a movable hopper placed anywhere between the track stringers, and into a chute flexibly hung on ropes, which guided the concrete to the proper points, if within its scope, or onto 8 by 3 foot platforms, from which it was shoveled or wheeled to place. Baffle boards were required to keep the larger stones from leaping away from the mortar, which flowed more slowly along the bottom. These were short 2 by 11 inch plank, hinged at upper end by two spikes driven through the vertical sides of the 12-inch open-topped chute. On most of the work the concrete was made quite wet—not so wet that any water to speak of would run away from the loose pile on the platform—but wet enough that when the mortar was in excess of the voids it would quake in tamping and become quite sloppy.

One barrel of cement in 50 was tested for fineness, time of initial set, 7 and 28 day strength of mortar, and subjected to the 24-hour boiling test. Briquettes were made as recommended by the committee of the American Society of Civil Engineers, using 1 part by weight of unsifted cement, 3 parts dry sand, and 12 per cent 0.48 part water. The sand was screened from that used on the work, using only what was held on a No. 40 sieve, and had been passed through a No. 15 to take out the few pebbles and bits of shells. From three-fourths to seven-eighths of the sand would pass the No. 40 and over one-half a No. 50 sieve. The cement proved satisfactory. But there was a great lack of uniformity, on account of which cement was taken from three barrels for each batch of concrete or mortar that went into parts of the work where homogeneousness was most desired. At 7 days the averages in strength ran from 100 pounds to 231, with a mean of 150. At 28 days the corresponding figures were 142, 294, and 204 pounds; 86 per cent of the wet briquettes broke at the center, but of a lot of hard, dry ones over three-fourths broke under the brass rollers of the clips. Among other experiments some briquettes were made using all the sand that passed sieve No. 15 (the finest included). Briquettes from this sand made in all respects like the standard ones—same man, same hour, same cement, same formula (using weights)—averaged 2 per cent stronger at 7 days, and 7 per cent stronger at 28 days. Another lot made in the same manner, but using only the sand that passed through the No. 40 sieve, averaged 22 per cent weaker than the standard at 7 days and only 10 per cent weaker at 28 days. We are now less anxious than before to send teams far out at low tide to get, at greater expense, from among the rocks a little coarse sand and gravel, to be afterwards screened for use in facing, etc. Fine-sand ceilings are now just as good and present a better appearance. In making the

1 to 3 mortar for ceilings, roofs, finishing, etc., and concrete for the upper course the ingredients were thoroughly mixed dry before the water was added, but for the bulk of the concrete water was the first to be admitted. Facing mortar was mixed in smaller batches by hand. Coarse-sand mortar is sufficiently mixed with a little less labor than the fine, and it works a little better under the trowel and sets faster.

It is not practicable to give correctly the itemized labor cost of this work, nor would it be of value unless accompanied by voluminous specifications, details, and explanations. The job was small, and only a small force was justified, not half enough to work the plant to its full capacity. So many odd jobs had to be done in their turn that not for a single day were the men engaged continuously on straight concrete work. Common labor was paid from $2 to $2.50 per day; skilled, $3.25 to $4.50. The work was nearly completed in February. To finish these emplacements it remains only to put in the gun-well linings when they come and fill in the annuli left around them, which vary by steps from 2 feet wide on top to 2 inches wide on the bottom; also to do the plumbing in the latrine.

Torpedo casemate.—At the beginning of the year the engine-room addition to the mining casemate was nearly completed. The remaining work on passage and steps to the other room, laying floor, installing machinery, putting in doors, windows, and shutters, painting, etc., and putting up a neat picket fence around the stairway and light well were all completed at an early date. Later a battery case was built in the engine room. It has two perforated shelves for the storage battery and a third for signal battery, etc. All the front is easily removable in sections. An earthenware pipe leads from the top of the case to one of the ventilating flues in the ceiling. Its lowest joint is an 8-inch tee, through the side opening of which may be placed a lamp or a fan to insure proper circulation. The cracks around the doors will be the inlets. Between the top of the case and a ceiling 2 inches below it are partitions that form a continuation of the flue, in three branches, to tap the case over each end, as well as the center, through numbers of auger holes proportioned in a manner to their distances away.

Torpedo storehouse.—A small wharf was built reaching out to between half tide and low water, and tramways of 3-foot gauge were laid, connecting it with the storehouse and tank house. Roof trusses and shutters were painted. The work is completed.

Battery commander's station.—The walls of this building are nearly completed, and the ironwork lately arrived is now being erected. It departs from the typical plans in several respects. A heavy 6-inch I-beam plate takes the place of the cast-iron one all around. The horizontal diagonal ties are omitted. The roof is lowered a foot (with respect to the instrument), so is the floor, except a step around the pedestal. The 15-inch I-beams and 12-inch channels over the broad openings are omitted. In place of the wooden shutters counterweighted iron ones three-fourths inch thick, three sections to a side, are hinged to the I-beams to swing out. Iron shutters are provided for the rear windows and door. The iron, all told, weighs about 9,900 pounds. Local conditions—exposure and isolation—suggested the changes.

Preservation and repair of fortifications.—The keeper was busily engaged during the year in caring for boats, buildings, tools, etc., and fortification works still in the charge of the Engineer Department, and on construction work and surveys. The watchman at the torpedo storehouse cared for the mining material in accordance with the general instructions. All electrical instruments, including the dynamo, were hermetically sealed in tin-lined boxes. The loaded compound plugs, used in 1898, were all shot off. The dynamite was inspected occasionally, and is still in good condition.

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3 V.

DEFENSES OF SAN FRANCISCO, CALIFORNIA.

Officer in charge, Maj. Charles E. L. B. Davis, Corps of Engineers; assistants, Lieut. (now Capt.) Herbert Deakyne, Corps of Engineers, until April 23, 1900; Lieut. William Kelly, Corps of Engineers, until June 29, 1900. Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers. Officer in charge of torpedo defenses, Lieut. Col. William H. Heuer, Corps of Engineers; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers, until January 29, 1900.

BATTERIES ON SOUTH SIDE OF BAY.

At the close of the last fiscal year the condition of the work was as follows:

Emplacement for 8-inch rifle on disappearing carriage.—The emplacement was completed except hanging the doors, painting rooms, installing electric-lighting plant, trolleys, and ammunition hoists, finishing latrine, and setting base ring.

Emplacements for three 8-inch rifles on disappearing carriages.—These emplacements were completed except hanging doors, installing electric-lighting plant and trolleys, plumbing in latrine, top-dressing some of the slopes, finishing the road, building a fence around the battery, and setting the base rings.

Emplacements Nos. 6 and 7 for 12-inch rifles on disappearing carriages.—Work was completed with the following exceptions: Laying the floor of the dynamo room, putting in electric lights and wires, finishing latrine, setting base rings, and building concrete aprons in front of the guns.

Emplacement No. 8 for 12-inch rifle on disappearing carriage.—With the exception of the electric lights and wiring, all of the engineering work was completed and the gun was mounted.

Emplacements Nos. 9, 10, 11, 12, and 13 for 10-inch rifles on disappearing carriages.—With the exception of the electric lights and wiring, all engineering work was completed and the guns were all mounted.

Emplacements Nos. 14, 15, 16, 18, and 19 for 12-inch rifles on barbette carriages.—With the exception of the electrie lights and wiring, all engineering work was completed and the guns were all mounted.

Emplacements B and C 5-inch rapid-fire guns.—The work was completed as far as it was practicable to go without the ironwork of the balanced-pillar mounts.

Pneumatic dynamite gun battery.—The engineering work was completed excepting about one twenty-fifth of the back filling, top-dressing some of the slopes, building road leading to battery, installing electric lights in the magazines and covered passages, and making some minor changes in the arrangement of certain rooms in the power house.

Mortar battery No. 1.—All engineering work was completed and the sixteen 12-inch mortars mounted.

Mortar battery No. 2.—Battery completed and guns mounted, but the electric-lighting plant was still to be installed.

Electric lighting.—Plans and specifications for the electric-lighting system were prepared and proposals solicited by public advertisements, bids to be opened July 7, 1899.

Land for fortification purposes.—A report upon the amount of land required was submitted June 27, 1899.

WORK DONE DURING THE YEAR.

Emplacement for one 8-inch gun on disappearing carriage.—In July, 1899, the latrine was finished and the rooms of the battery were painted with two coats of zinolith. In September a fence was built around the battery, the doors were hung and painted, and the trolleys installed. During the months of November and December the electric-lighting plant was installed by contract. During March, 1900, speaking-tube connections were made between the type B range finder, the two 8-inch converted rifles, and the relocator room.

The excavation was in clay to a depth of about 5 feet, where it changed into soft rock, getting harder as the depth increased. It was moved by blasting and loading into dump carts, at an average cost of 69 cents per cubic yard. The foundations were uniformly good under the entire emplacement, and no difficulty due to unequal settlement has occurred.

Concrete was mixed by hand, the proportions being 1 of cement, 3⅓ of sand, and 8 of rock, measured by volume; that is, 36 feet of rock and 15 feet of sand were used to each barrel of Portland cement. Six men were used to turn each bed, the material being turned twice dry and once wet. The rock was crushed to required size and delivered on the mixing platform by contract. The sand was scraped up on the beach below and hauled to the battery by hired teams. All possible precautions were taken to prevent leakage. Walls in contact with the earth were plastered and painted with paraffine paint and drain tile were placed at the bottom of them. Partition tile were placed around all the rooms and on three sides of the magazine. These tile are 6 by 12 by 12 inches, there being a partition in the center dividing them into two parts 4⅞ by 4½ inches, interior measure. They are placed in the concrete about 2 feet from the inner wall, and extend from a trifle below the floor to a foot or two above the ceiling. At the bottom is a gutter, draining into the sewer system. The tile are set over this gutter in mortar and the concrete placed on each side of them. In this way the air spaces run continuously from the top to the gutter below. Tile 6 by 6 by 12 inches outside and 4½ by 4½ inches inside are used to cover the top. They are grooved so that one side can be knocked out before they are placed in position. The cost of placing these tile is about 23 cents per square foot. A damp-proof course of asphalt was placed in the concrete about 2 feet over the magazine, extending to the outer edge of the partition tile and having a slight crown. This course was about 1 inch thick, and consisted of 85 per cent pure asphaltum and 15 per cent sand. It was laid by contract, at a cost of 15 cents per square foot.

The top surfaces were covered with a smooth cement finish about 2 inches thick and marked off into squares like a sidewalk. In some places this finish cracked along the grooves marked on it, causing slight leaks. These leaks were completely stopped by filling the grooves with grout.

The ammunition hoist and base ring are still to be set in place before the battery is completed, and this work will be done as soon as they arrive, and the emplacement turned over to the artillery.

The following is a detailed statement of the cost of this emplacement:

Taking down flagstaff: Labor		$50.00	
Excavation for and erection of flagstaff:			
Labor		69.00	
Teams		13.50	
			$132.50
Material—			
8 barrels cement	$22.75		
28,800 pounds rock	20.16		
12,000 pounds sand	2.23		
	45.14		
Moving guardhouse: Labor			97.50

Excavation:				
Labor			$3,104.75	
Teams			716.12	
				$3,820.87
Explosives—				
400 pounds Hercules, No. 2			47.44	
1,500 pounds Champion			97.05	
3,000 feet fuse			15.00	
5 boxes caps			2.70	
				162.19
Sharpening tools, smith's work			158.67	
Material—				
49 pounds octagon steel		$3.19		
4 dozen shovels		30.00		
Railroad picks and handles		13.30		
Chalk lines		.60		
			47.09	
				205.76
Drains, sewers, and sumps:				
Labor			229.50	
Material—				
Drain and sewer pipe			104.50	
				334.00
Rock, 161,970 pounds		113.38		
Gutter:				
Concrete work				80.00
Material—				
25 barrels cement			71.10	
42,000 pounds rock			29.40	
24,000 pounds sand			4.46	
				104.96
Grates:				
Smith's work				8.00
Material—				
7 cesspools			5.60	
2 manhole covers			22.00	
				27.60
Forms:				
Carpentry			1,086.75	
Material—				
34,800 feet r. o. p.	$499.68			
13,461 feet tongued and grooved	310.95			
800 r. w. wedges	7.60			
600 feet electric-light strips	11.92			
		830.15		
Nails	18.65			
1 dozen files	.66			
		19.31		
			849.46	
Tramway:				
Carpentry			126.00	
Material, 2,940 feet o. p.			44.38	
Hauling material—				
Labor			93.00	
Teams			26.75	
Taking down forms:				
Labor			185.50	
Teams hauling lumber from emplacement			34.87	
				2,446.71
Concrete work (see Appendix):				
Loading and hauling cement—				
Labor			96.00	
Teams			60.23	
Loading and hauling sand—				
Labor			132.75	
Teams			364.99	
Weighing rock			84.50	

Concrete work (see Appendix)—Continued.			
Mixing, placing, and ramming		$2,456.50	
Teams		236.87	
			$3,431.84
Materials—			
1,819 barrels cement		4,460.33	
6,371,900 pounds rock		5,173.24	
2,677,800 pounds sand		497.80	
			10,131.37
Placing I-beams:			
Labor		35.00	
Material, 107 I-beams		324.14	
			359.14
24 bolts for base ring		59.43	
5 ringbolts		40.00	
			99.43
Tools:			
12 tampers		$12.00	
2 dozen wheelbarrows		84.00	
3 dozen shovels		22.50	
			118.50
Material:			
Cement, 1,900 barrels		5,065.00	
Lighterage		207.15	
Storing:			
Labor	$83.00		
Teams	49.28		
		132.28	
			5,404.43
Rock, 6,651,970 pounds			4,656.36
Laying partition tile:			
Labor		88.00	
Material—			
Tile		274.00	
			362.00
22 barrels cement			62.57
Plastering and pointing:			
Labor			532.50
Material—			
48 barrels cement	136.51		
70,000 pounds sand	13.01		
	149.52		
Top finish and floors:			
Labor (mason's)		262.00	
Hauling sand—			
Labor		17.00	
Teams		45.00	
			324.00
Material—			
165 barrels cement	469.26		
47,300 pounds rock	33.11		
11,700 pounds sand	2.18		
	504.55		
242 pounds lampblack	27.18		
1 sand screen	8.00		
1 sieve	.75		
			35.93
Flues and ventilators:			
Labor		42.00	
Chimney bases and caps	9.05		
Grates	15.00		
		24.05	
			66.05
Asphalt covering of magazine			52.20

Paraffine painting:			
Labor		$23.00	
Material, 1 barrel paraffine paint		45.00	
			$68.00
Back filling and top-dressing:			
Labor		1,230.50	
Teams		321.61	
Material—			
Manure	$22.00		
One-half dozen manure forks	2.00		
		24.00	
			1,576.11
Stairs of parapet:			
Carpentry		22.50	
Material, lumber		6.87	
			29.37
Speaking tubes:			
Labor		25.00	
Mouthpieces and flexible tubing	3.99		
G. I. pipe and fittings	19.58		
14 brass plates	2.47		
		26.04	
			51.04
Trolleys:			
Labor		23.00	
Material, trolley system		175.00	
			198.00
Doors:			
Carpentry		49.50	
Smith's work		149.83	
Mason setting hinge blocks		24.00	
Material—			
Hinge blocks and pins	62.88		
Iron	21.16		
Bolts	17.34		
Lumber	18.42		
8 Bohannan locks	6.15		
		125.95	
Painting doors:			
Labor		44.00	
Material—			
Paint	1.44		
Sandpaper	.09		
		1.53	
			394.81
Painting rooms:			
Labor		49.00	
Material—			
30 gallons zinolith	30.00		
5 kalsomine brushes	8.35		
		38.35	
			87.35
Latrine:			
Carpentry		76.00	
Plumbing work		76.00	
Material—			
Lumber	88.85		
Doors	7.95		
Hardware	5.53		
Fixtures	347.07		
		449.40	
			601.40
Water supply:			
Labor		58.00	
Material—			
Pipe and fittings	35.76		
8 bibbs	6.00		
1 globe valve	.65		
		42.41	
			100.41

Roads:			
Labor		$271.00	
Teams		14.25	
			$285.25
Policing			19.00
Holidays			104.00
Fence:			
Labor		215.00	
Material—			
869 feet R. W	$13.29		
6,669 feet O. P	111.57		
5 kegs nails	21.35		
		146.21	
			361.21
Wagon work:			
Labor		107.33	
Material—			
Bolts and washers	2.04		
3 wagon poles	7.50		
½ dozen fellies and spokes	1.59		
4 dozen clips	1.60		
		12.73	
			120.06
Horseshoeing:			
Labor		55.67	
Material—			
3 kegs shoes	10.80		
3 pounds nails	2.17		
105 pounds toe steel	2.63		
		15.60	
			71.27
Stables:			
Forage—			
23,467 pounds barley, 12,512 pounds oats, 2,252 pounds bran, 85,457 pounds hay, 7,750 pounds straw, 100 pounds salt		1,272.98	
2 cases axle grease		3.60	
			1,276.58
Range finder (repairs):			
Forms, labor		9.50	
Base of instrument, labor		14.00	
			23.50
Electric plant:			
Dynamo		1,253.00	
1 fan motor		14.80	
			1,267.80
Miscellaneous:			
Blacksmith shop—			
24 pounds Norway iron	0.89		
25 pounds borax	1.63		
2 drills	.86		
Extra parts of drill	3.00		
		6.38	
Cement testing—			
1 pointing trowel	.15		
1 dozen g. i. pans	6.00		
		6.15	
4 bull's-eye lanterns	5.00		
1 conductor's lantern	.45		
		5.45	
			17.98
Field office: Salaries			935.00
City office:			
Salaries		814.17	
Rent		70.00	
			884.17
			31,229.82

To which add estimated cost of work required to complete battery—		
Ammunition hoist	$800.00	
Labor installing same	110.00	
Setting base ring and finishing pit	29.00	
Door for ammunition hoist	20.00	
		$959.00
Total		32,188.82

RECAPITULATION.

Cost of concrete.

Concrete mixed by hand:	
Framework	$2,446.71
1,819 barrels cement at $2.844 per barrel	5,173.24
6,371,900 pounds rock at $0.70 per 1,000 pounds	4,460.33
2,677,800 pounds sand at $0.1859 per 1,000 pounds. As the cost of sand is the scraping, loading, and hauling from beach, it is included under incidentals with weighing rock and hauling material.	
Mixing, placing, and ramming	2,456.50
Incidentals	975.34
Total	15,512.12

The relation of loose material to concrete rammed in place being taken as 100 : 70 gives 2,350 cubic yards at $6.60 per cubic yard:	
Framing	$1.041
Cement	2.201
Rock	1.898
Mixing, placing, and ramming	1.045
Incidentals	.415
	6.600

Emplacements for three 8-inch rifles on disappearing carriages.—In July, 1899, the road was finished, all of the slopes top dressed, and one base ring set. During August the setting of the doors was completed and the trolleys were installed. During September the painting of doors and plumbing of latrine were completed. In October the remaining base rings were set and a commencement made on erecting the lighting plant. In December the lighting plant was completed, the guns were mounted, and the battery turned over to the artillery the following month. In April the concrete surfaces, exposed to view from the harbor, were painted with paraffine paint to conceal them.

Emplacements for two 5-inch rapid-fire wire-wound guns.—Work was begun in January, 1900, and was carried along continuously until June, at which time it was practically completed.

In estimating the cost it was supposed that the material encountered in the excavation would be sand to a depth of 7 or 8 feet and clay for the remainder of the distance, such being the character of the ground of the 8-inch emplacement about 170 feet to the east. Instead rock was met with about 4 or 5 feet below the surface. The average cost of the excavation was 65 cents per cubic yard, which was 10 cents per yard more than the estimate.

The magazines being on a lower level than the platforms, it was thought best to build them entirely separate, leaving planes of weakness between them and the platforms. Every precaution to prevent leaking was taken, drain tiles being placed around the walls, which latter were plastered and painted with paraffine paint.

Concrete was made by hand, the proportions being 1 of cement, 3¼ of sand, and 8 of rock by volume. It was mixed three times, twice dry and once wet, by six men, and about 85 cubic yards per day were put in place.

The battery is lighted by the electric plank of the adjoining 8-inch battery; the lights and wires were put in by employees of the Engineer Department. The interior wiring is on porcelain cleats screwed to wooden strips in the concrete, and the exterior wiring is carried by poles.

At the present time the battery is completed except setting the base rings and whitewashing the rooms. The base rings will be set as soon as received, and the rooms will be whitewashed as soon as the concrete dries sufficiently.

Emplacements for two 15-pounder rapid-fire guns.—In May, 1900, instructions were received to select a site and prepare plans and estimates for the construction of two emplacements for 15-pounder rapid-fire guns on balanced-pillar mounts, and at the close of the fiscal year the plans had been completed.

Emplacements Nos. 6 and 7 for 12-inch rifles on disappearing carriages.—The floor of the dynamo room was laid in July, 1899; aprons were built, one base ring set, and latrines finished in August, and the other base ring set in October, and the battery entirely completed in November. The artillery have mounted the guns and have had the emplacements turned over to them.

Emplacements Nos. 9 to 13, inclusive, for 10-inch rifles on disappearing carriages.—Steps at emplacements Nos. 11 and 12 were repaired.

Emplacements Nos. 14, 15, and 16, for 12-inch guns on nondisappearing carriages.—A latrine was built for this battery. It consists of a concrete building 8 by 20 feet, divided into two parts by a wooden partition, one part being reserved for the officers and the other for the men. The officers' part contains a basin, a stall urinal, and one closet; the men's contains a sink, a range urinal, and three closets.

The cost was as follows:

Excavation	$44.00
Concrete	180.22
Pointing and plastering	41.00
Doors	14.03
Backfilling	37.15
Plumbing, including installing	491.12
Painting	5.90
Sewer	96.06
Holidays	16.00
Total	925.48

Two emplacements for 5-inch rapid-fire guns on balanced-pillar mounts.—Nothing was done on this battery during the year, owing to the nonarrival of ironwork of the balanced-pillar mounts.

One emplacement for a 5-inch rapid-fire gun on balanced-pillar mount.—On June 3, 1899, an allotment of $6,000 was made for this emplacement, which forms emplacement D of a group of four for which plans and estimates have been submitted, and of which two were partially constructed at the close of the last fiscal year.

The excavation was begun and completed in May, 1900, the main road to the battery repaired, and sufficient loam for top dressing the slopes collected in front of the battery. Work was then suspended awaiting the arrival of the ironwork of the balanced-pillar mount.

Pneumatic dynamite-gun battery.—This battery is situated near the edge of a steep bluff, between emplacements Nos. 16 and 18. Between the guns and the road there was a fringe of small trees that very imperfectly screened the battery, so the guns were in plain view when elevated, and the power house in rear was a very conspicuous object, particularly when steam was up. Both guns and power house were set directly on the natural surface of the ground, with but little grading and no attempt whatever at protection. Much study was given to the question of protection by various officers, and in May, 1898, Col. C. R. Suter, Corps of Engineers, submitted a project calling for the expenditure of $150,000 for magazines and covering parapets. The principal item of cost was the protection of the power house, which was effected by a high earthen traverse carried nearly around the building, the earth being kept as near and as high as possible by a concrete retaining wall. An area 10 feet wide is left around the building and the unexposed end left uncovered to allow access to the house. Under this traverse are located magazines and the usual service rooms. Covered passages afford communication between the gun pits, power house, magazines, etc. The deficiency act approved July 7, 1898, appropriated $150,000 for the construction of magazines and parapets for the battery in question.

The parapet and traverse were completed. They were built of sand borrowed from a bank about 1,800 feet from the battery. A steam shovel was used to load the sand into cars, which were then pulled up the hill in trains of six cars by a hoisting engine with a cable. The maximum capacity of the shovel was about 150 cubic yards per hour, but it was never run to its full capacity, on account of the slowness of the hoisting machinery. The hoisting engine was a 35-horsepower Westinghouse junior steam engine, and it pulled the six cars, containing about 11 cubic yards of sand, up a grade of 12 feet in 100 at about the rate of a horse walking. The hoist was about 900 feet long. At the top of the hill horses were used to haul the cars up on to the dump.

The slopes were all made 3 on 4, and owing to the strong winds it was found necessary to build them up with pine brush in order to keep the sand in place. This was done by cutting the brush to a length of about 3 feet and placing it in horizontal layers, so that the brush ends just showed on the outside of the slope. Over each layer of brush was placed about 6 inches of sand, which was well tamped before the next layer of brush was placed. By carrying the slopes up in this manner the blowing away of the sand was almost entirely prevented. The slopes were finished by covering them with 12 inches of black loam and planting them with oats. They all withstood the heavy winter rains except at one point, where the drainage from a large top area poured down. At this locality a cobblestone gutter about 3 feet wide was built, and proved effective in preventing wash during the rains which occurred after it had been built.

The cost of getting the sand into position was as follows:

Labor	$16,103.45
Hire of plant, teams, etc	8,607.32
Repairs to plant	629.28
Tools, etc	539.61
Total	25,879.66

About 90,000 cubic yards of sand were used, which made the cost about 28¾ cents per cubic yard.

Just in front of the power house is a retaining wall 35 feet high. Owing to poor foundations and the great weight of pure sand behind, it cracked quite badly and showed signs of giving way. In order to remedy this seven iron rods were driven through the sand to the rear walls of the gun pits, large washers and nuts being put on both ends and the nuts screwed up, thus tying the walls together. The rods were 1½-inch Norway iron about 120 feet long. They were pointed on one end, blocked up on trestles to give them the proper direction, and were driven by means of a ram wielded by four men. The last of these bolts was put in during the month of January, 1900. The cracks were then cleaned out and plastered up, and up to the present time have shown no signs of opening again. The engineer work has been entirely finished and that portion of the battery constructed by the Engineer Department turned over to the artillery on June 8, 1900.

Emplacements for two 6-inch guns on disappearing carriages, part of the heavy rapid-fire armament.—The excavation for this battery was started on July 5, 1899. The material was partly clay and partly rock, and was moved by blasting and loading into dump carts by hand. A road about 1,500 feet long had to be built to connect the battery with the main road. The rock taken from the excavation was used to macadamize almost the whole of this road. The erection of the concrete plant was started in July and the forms were ready to be set up. In August the excavation was completed, the concrete plant set up, the water-supply and sewer system put in, the foundations laid, and some of the forms put up. The arrangement of the concrete plant was a very good one, as it permitted the handling of the material almost entirely by gravity. A long platform was built for the reserve pile of stone on the hillside in rear of and above the battery. The stone and sand were drawn from this platform through hoppers into the measuring cars. These cars were then pushed by hand to a hopper directly over the mixer and dumped. The cement was dumped into this hopper at the same time and the materials were then let into the mixer. About 40 gallons of water were used to each batch, which consisted of 36 cubic feet of rock, 15 cubic feet of sand, and 1 barrel of Portland cement. The mixer was turned from twelve to fourteen times, and then the mixed materials were dumped into cars which were pushed by hand along trestles and dumped at the desired places. The force required to run this plant consisted of three men supplying materials, one man handling the mixer, one engineer, one fireman, and one man to dump the mixer. The cost of labor was $14.67 per day. When running well the plant would mix about 250 cubic yards of concrete per day.

Many difficulties were met with in building this battery, which caused delays and greatly increased its cost. Two thousand two hundred barrels of cement delivered at the works proved to be poor and had to be rejected. To replace this rejected cement other cement had to be bought at once in open market at a much higher price, the extra cost being about $1,875.

In September, 1899, just as the concrete work was ready to start, the water supply was shut off. At that time there was a large number of troops encamped at the Presidio Reservation on their way to Manila, and it being the dry season, the water supply became so scant the post quartermaster suddenly determined to economize by stopping the supply for fortification work. As there was no prospect of any improvement of conditions for a considerable length of time, it was thought best to make other arrangements to carry on the work. Point Lobos Creek, forming part of the southern boundary of the reservation, was dammed up, an old flume, formerly used by the Spring Valley Water Company, was repaired and practically rebuilt to a point on the beach just below the battery, and from this point the water was pumped up to a tank just above the concrete plant, a small steam pump being brought from another site for this purpose. The total cost of installing this water system was about $475, and the running expenses about $90 per month.

Concrete work was started in October and carried on as rapidly as possible until completed early in December.

The work was also considerably delayed by the rains, which not only stopped the work but made the roads so soft that there was great difficulty in getting broken stone to the battery. By April, 1900, the engineering work was completed, except painting, putting up the trolleys, completing the plumbing, and setting the base rings. All the concrete surfaces exposed to view from the harbor side were painted with paraffine paint to conceal them. By June the battery was entirely completed, the artillery had mounted the carriages, and recommendation was made June 22, 1900, that the emplacemements be turned over to the artillery. The guns have not yet arrived.

Electric lighting.—The plan finally adopted for lighting the batteries by electricity divides the various emplacements from Nos. 6 to 19, inclusive, into three groups, as follows: Group No. 1 includes Emplacements Nos. 6 to 16, inclusive. The dynamo room was built of concrete in the slope to the right of the entrance to magazine of Emplacement No. 13; it is 26 by 12 by 9 feet. Provision is made for 193 16-candle-power incandescent lamps, there being a 16-horsepower Hornsby-Akroyd oil engine driving a 15-horsepower dynamo. The various emplacements of this group are connected by a pole line between the batteries, set in rear of the roadway at the foot of the rear slopes.

Group No. 2 includes Emplacements Nos. 18 and 19 and the emplacements for two 6-inch rapid-fire rifles on disappearing carriages constructed some distance in front. The dynamo room is built in the slope to the right of No. 19, its interior dimensions being 24 by 12 by 8 feet. A 7-horsepower Hornsby-Akroyd oil engine runs a 5-horsepower dynamo, lighting the two batteries. The connection between the batteries is by weatherproof wire strung on poles.

Group No. 3 is made up solely of mortar battery No. 2, which requires a 20-horsepower Hornsby-Akroyd engine and a 15-horsepower dynamo for its 156 lamps. The dynamo room is situated about the center of the battery, one of the guardrooms being used for this purpose. The interior wiring in all these plants is on porcelain cleats screwed to wooden strips set in the concrete walls for this purpose.

Each plant is provided with a switchboard, 40 by 32 inches, mounted on heavy brass hinges and so arranged as to fit into a recess in the concrete wall of the building. On each switchboard are mounted:

Two brass lamp brackets with shades.
One ammeter of proper capacity.
One voltmeter.
One field rheostat for dynamo.
One ground detector and switch.
One main dynamo switch with fuses.
Two double-pole circuit switches with fuses, and
Two lightning arresters.

Safety fuses are placed on all leads at the starting point of a branch of smaller cross section than the lead other than a single-lamp branch, the fuses being arranged to break the circuit when the normal current is exceeded by one-third.

All of the above electric-lighting plants were furnished and installed by the Wybro-Hendy Company, of San Francisco, Cal., under contract dated August 12, 1899, for the sum of $8,814.

Emplacements for two 12-inch guns on disappearing carriages.—Work on this battery was begun in September, 1899. The excavation for the foundations of the emplacements was in sand to a depth of about 6 feet and in clay for the remainder of the distance, the deepest cut being about 17 feet. Throughout the clay were distributed hard quartz bowlders, which had to be broken up before they could be moved. The sand was scraped off the top with 4-horse Fresno scrapers. Each scraper moved on the average 70 cubic yards per day, at a cost of about 12 cents per cubic yard. The clay and rock were moved by blasting and loading into dump carts by hand. The rock was used, as far as it would go, for foundations of the roads. The average cost of the entire excavation was 42 cents per cubic yard. The foundations were all in clay except at two points under the breast wall. At these points the sand was dug out and two masses of concrete 6 by 12 feet in cross section were built resting on the clay.

During the month of October, 1899, a blacksmith shop, carpenter shop, and cement shed were built. These buildings were all covered with 1 by 12 inch redwood with battens, the roofs being shingled. The cement shed will hold about 4,500 barrels of cement. The road to the site was also nearly finished during this month, the foundation being built mostly of rock obtained from a ridge just in rear of site of the battery. The material used to macadamize the road was red rock, furnished and delivered by contract at the rate of 58 cents per cubic yard. The road is 20 feet wide and cost about $1.90 per running foot, including grading, rolling, etc.

In November the excavation for the battery was practically completed and some of the sewers were laid. The main sewer drains out upon the sandy hillside to the left and front of the battery and can be connected with the city system whenever the system is extended out that far. An office building and second cement shed were built, most of the forms for concrete made, and the erection of the concrete plant started. It was decided to be unnecessary to build stables, as the contractor who furnished horses succeeded in getting stable accommodations near by.

In December the road to the battery was entirely completed and rolled. The excavation was finished and the sewers and foundations were all laid. The forms were all finished and about one-fifth of them set up and the erection of the concrete plant completed. This plant consisted of a cubical mixer, with the necessary machinery for supplying and running it. A large platform was built on top of the ridge in rear of battery, and on the side nearest the battery were placed two hoppers, one for stone and one for sand. On the platform was stored about 2,000 tons of broken stone to serve as a reserve. This was necessary, as the contractor could furnish only about 250 tons per day, while 360 tons were used. Both sand and rock wagons dumped directly into the hoppers whenever possible, thus permitting most of the materials to be handled without shoveling. The stone and sand were drawn from the hoppers as required into the measuring cars, which were then hoisted on an elevator and dumped into a hopper just over the mixer. The cement was dumped into this hopper and all of the materials let into the mixer, about 40 gallons of water being put in at the same time. The mixer was then turned from twelve to fourteen times and then dumped into the cars, which were pushed by two men out on trestles over the site of the battery and dumped wherever desired. The same engine turned the mixer and worked the elevator. During the entire run of this plant the average amount mixed per day of eight hours was 280 cubic yards, the maximum run being 337 cubic yards. The proportions of the concrete used were 1 of cement, 3½ of sand, and 8 of broken stone. The cement used was all Portland, the brands being "Cannon," "Hemmoor," "Josson," "Scales," and "Germania." It was purchased at the city water front and hauled to the storehouses at the work by contract. The average cost per barrel on the work was $3.03. The sand was scraped up on the ocean beach by the Engineer Department, but loaded and hauled to the battery by contract, at a cost of 49 cents per cubic yard. The stone was crushed and delivered at the battery by contract at the rate of $1.375 per ton. The force required to run this plant consisted of two men to load the measuring cars and place them on the elevator, two men to dump them into the hopper over the mixer, two men to supply the cement, one man to manage the mixer, one engineer, one fireman, and one man to dump the mixer into the cars. Besides this force from ten to twelve men were required to shovel stone from the reserve pile into the hopper whenever stone was not being delivered fast enough. Whenever they could be spared from this duty these men were employed in placing large rubble rock in the wide concrete walls. A 2-horse team was able to bring the cement from the shed to the mixer as fast as it was used. One man was employed to break up the cement barrels for use as fuel for the engine.

The water supply for the concrete was quite a serious problem. There was no water on the reservation, and there was not pressure enough in the main constituting the nearest supply to supply water at the battery, consequently a 400-gallon redwood tank was placed at the lowest point on the reservation and filled by a 1½-inch pipe from the water main. The steam pump used at the 6-inch rapid-fire battery was set up near the tank and pumped the water as required up to a wooden tank on the platform above the concrete plant. This same system was used to supply water to the mortar battery afterwards.

About three-quarters of the reservation when work was started was barren sand dunes, over which the winds had a clear sweep. It was necessary to take steps to reclaim this land in order to control the drifting sand. Part of the reservation was covered with a thick growth of bunch grass (*Arundinario*), the seed of which was imported from France many years ago by the city park commissioners and set out on the ocean front to reclaim the sand dunes. A portion of this grass was transplanted to the barren area, it being planted in small tufts about 2½ feet apart, each tuft having its roots and tops trimmed off and being stuck about 3 inches into the ground. About 35 acres were planted with this grass, and all of it has lived. It grows rather slowly at first, but after it gets a good start it spreads quite rapidly and sends out roots which extend to a depth of 7 or 8 feet. In order to hold the sand while the bunch grass was getting a start, oats were sown over the entire area. They came up in a day or two and grew well as long as the rainy season lasted, but died as soon as the dry season came on. About 800 spruce trees were transplanted from the Presidio Reservation, but all have died. They were about 8 or 10 years old and had been growing in sand, so that it was next to impossible to keep any earth around the roots while being moved. Four thousand young eucalyptus trees were purchased, at a cost of $18 per 1,000, and were planted where they will best serve to break the wind. Nearly all of these trees have lived and are growing well. They are only 10 or 12 inches high now, but in the course of four or five years they will be large trees. The summer trade winds set in about two months ago, and no trouble has been experienced as yet from the drifting sand, and none is apprehended.

Concrete work was started about the 1st of February, 1900, and was carried along without delay until completed in March. Partition tile were placed around all the rooms, forming an air space 2 feet from the interior walls, the method of construction being the same as described for the 8-inch battery, the cost being 14 cents per square foot. The outside walls were plastered, at a cost of 3 cents per square foot, and then painted with paraffine paint, at a cost of 1¾ cents per square foot.

By the end of April all engineering work was completed except installing the electric-lighting plant, ammunition hoists, trolleys, part of the latrine plumbing, setting the base rings, hanging some of the doors, and painting the battery. During May the installation of the electric-lighting plant was practically completed by the contractor; the trolleys and doors were put up, and the plumbing and painting completed. In June the ammunition hoists were installed and the battery entirely completed except setting the base rings, which have not yet arrived, and whitewashing the interior of the battery, which can not be done until the concrete has dried out more thoroughly.

The following is a detailed statement of the cost of this battery:

Road to emplacements:		
Labor	$1,707.75	
Teams	962.53	
		$2,670.28
Material—		
1,305 cubic yards red rock	757.87	
Salt water	4.18	
Use of roller and sprinkler	5.00	
		767.05
Total cost of road, $3,437.33.		
Buildings (2 cement sheds, blacksmith and carpenter shops, office, and outhouses).		
Grading:		
Labor	40.00	
Teams	111.15	
		151.15
Erection of buildings:		
Carpenter work	1,103.63	
Masonry	13.00	
		1,116.63
Material—		
64,771 feet o. pine	931.85	
4,820 feet 1 by 6, t. and g	115.39	
10,937 feet redwood	173.17	
1,304 feet rustic	31.68	
11,600 feet redwood battens	87.00	
1,508 feet redwood surfaced	29.72	
423 feet o. p. sugar pine and spruce	9.84	
Molding	4.37	

Erection of buildings—Continued.		
Material—Continued.		
88 M shingles	$154.00	
Doors, window frames, and sash	135.86	
1,200 brick	12.00	
3 barrels lime	3.90	
Hardware—		
20 kegs wire nails	85.00	
2 pounds brads	.16	
1 mortise lock	2.50	
8 rim locks	1.60	
1 night latch	.75	
27 pairs hinges	5.59	
8 pairs butts	2.60	
4 pairs barn-door hangers	7.20	
40 feet o. n. t. rail	4.80	
22 window fasteners	3.30	
1 drawer lock	.15	
6 padlocks	7.20	
1 dozen sheets tin	1.40	
17 gross screws	17.51	
Paints and oils	16.45	
2 brushes, stucco	2.17	
		$1,847.16
Stoves:		
1 "Ideal" stove	20.40	
1 "Veto" stove	10.05	
		30.45
Total cost of buildings, $3,145.39.		
Excavation:		
Survey and cleaning of site	188.00	
Excavation—		
Labor	3,813.25	
Teams	2,584.73	
		6,585.98
Material—		
Explosives—		
950 pounds Hercules No. 2	112.67	
3,000 pounds Champion	194.10	
1,000 pounds blasting powder	79.40	
4,000 feet fuse	22.56	
11 boxes detonating caps	6.49	
		415.22
Tools—		
4½ dozen shovels	51.75	
1 dozen railroad picks	8.00	
4 sledge hammers	5.06	
4 dozen sledge-hammer handles	5.20	
4 dozen pick handles	6.00	
1 dozen chalk lines	1.80	
17 pounds octagon steel	1.53	
		79.34
Total cost of excavation, $7,080.54.		
Concrete plant and tramway:		
Excavation	257.50	
Road to plant—		
Labor	476.00	
Teams	105.76	
Carpentry	831.40	
Material: 25,666 feet lumber, o. p	412.23	
Installation of machinery: Engineer and assistants	155.50	
		2,238.39
Material used in repair and running:		
1 friction cone and repairs	8.50	
2 Wadham grease cups	1.40	
1 c. i. pulley	18.50	
1 bronze bushing	10.00	
1 spur gear wheel	14.70	

Material used in repair and running—Continued.		
1 smokestack	$20.00	
100 feet wire	.50	
29 pounds rubber packing	19.65	
44 feet 4-ply belting, 10-inch	16.95	
1 drive punch	.25	
2 boxes Bristol belt lacing	4.00	
100 feet leather belt lacing	2.00	
100 pounds lubricant	13.75	
1 barrel machine oil	12.15	
4 Hobbs oilers	2.65	
1 bale cotton waste	9.74	
3 quires emery cloth	1.65	
6 laurel rollers	19.50	
2 pieces sheet iron, 20 by 96	1.69	
2 turning castings	7.00	
		$184.58
Total cost concrete plant and tramway, $2,590.97.		
Taking down concrete plant		168.00
Forms:		
Carpentry	2,559.14	
Teams hauling lumber	319.65	
		2,878.79
Material—		
79,402 feet lumber, rough o. p	1,339.55	
3,021 feet 1 by 3, t. and g	87.00	
24,109 feet 1 by 6, t. and g	629.23	
1,376 feet o. p. surfaced	24.60	
700 feet r. w. wedges	29.88	
2,000 shingles	3.50	
35 kegs wire nails	148.75	
		2,262.51
Taking down forms—		
Labor	484.75	
Teams hauling lumber from works	176.43	
		661.18
Total cost forms, $5,802.48.		
Concrete work:		
Putting up wagon scales	50.25	
3 T bearings	9.60	
Weighing and storing rock	227.50	
Supplying mixer—		
Labor	656.00	
Teams	585.61	
Mixing, placing, and ramming	3,218.15	
Engineer and assistants	468.50	
		5,215.61
Placing I beams		106.50
Materials embedded in concrete—		
385 I beams	2,361.53	
52 anchor bolts	864.88	
10 ring bolts	70.00	
3,594 feet electric-light strips	77.13	
		3,373.54
Material used in machine-made concrete (see Appendix)—		
6,314 barrels cement	19,140.89	
19,345,075 pounds rock	13,299.74	
9,237,600 pounds sand	2,490.46	
		34,931.09
Cost of material:		
Cement—		
2,200 barrels Cannon	6,226.00	
4,088 barrels Hemmoor	10,322.20	
1,012 barrels Germania	2,631.20	
Storage	657.69	
Drayage	2,218.88	
Receiving and storing at works	74.00	
		22,129.97
Cost per barrel, $3.0315.		

Rock: 19,697,375 pounds rock, at $1.375 per ton			$13,541.91
Sand:			
Scraping and hauling—			
Labor		$437.25	
Teams scraping and hauling under contract with C. S. Harney		702.00	
Teams hauling under contract with John Tuttle		1,525.82	
4 Columbus scrapers		31.00	
			2,696.07
Sand delivered at works:			
3,118 cubic yards by Tuttle, 585 cubic yards by Harney; 3,703 cubic yards, 5,000 tons.			
Cost of sand per 1,000 pounds, $0.2696.			
Plastering and pointing:			
Masons		1,109.00	
Teams hauling material		75.83	
Material—			
125 barrels cement	$378.94		
134,000 pounds sand	36.13		
		415.07	
			1,599.90
Top finishing:			
Masons			751.00
Material—			
375 barrels cement		1,136.81	
83,100 pounds rock		57.13	
300,000 pounds sand		80.88	
			1,274.82
Floors and sidewalks:			
Masons		658.00	
Teams hauling material		42.35	
			700.35
Material—			
164 barrels cement		497.17	
154,000 pounds rock		105.88	
209,500 pounds sand		56.48	
			659.53
Laying partition tile:			
Labor		128.50	
Material—5,000 tile		575.00	
			703.50
Paraffine painting:			
Labor		38.00	
Material—			
3 barrels paraffine paint	$135.00		
2 4-inch knot brushes	2.20		
20 gallons coal oil	4.00		
		141.20	
			179.20
Drains, sewers, and sumps:			
Labor		441.75	
Plumber		8.00	
Carpenter		7.00	
			456.75
Material—			
12 barrels cement		$36.38	
15,600 pounds rock		10.73	
75,400 pounds sand		20.33	
			67.44
Drain tile and sewer pipe		163.84	
19 cesspools and hubs		15.20	
2 manhole covers		21.00	
			200.04
Gutter:			
Carpentry (forms)		27.00	
Concreting and finishing		206.50	
			233.50

Gutter—Continued.			
Material—			
29 barrels cement		$87.91	
78,000 pounds rock		53.63	
39,000 pounds sand		10.51	
			$152.05
Grates: Smith's labor			35.84
Total cost drains, sewers, and sumps, $926.13.			
Back filling and top dressing:			
Rear slope—			
Labor		648.50	
Teams		222.00	
Manure		28.50	
			899.00
Front slope parapet—			
Carpentry, profile boards		233.69	
Labor		2,222.25	
Teams		1,562.13	
Manure		37.00	
			4,055.07
Total cost back filling and top dressing, $4,954.07.			
Planting grass on dunes:			
Labor			532.75
Material—			
1,400 pounds oats		27.46	
1 brush scythe blade		.50	
2 rakes		1.50	
			29.46
Total cost planting grass on dunes, $562.21.			
Fireplaces, chimneys, and ventilators:			
Labor		29.50	
Material—			
2 grates	$20.00		
Flue lining	7.20		
Chimney bases and caps	6.60		
Sewer pipe for ventilators	67.30		
Wire cloth	2.10		
		103.20	
			132.70
Latrine:			
Plumber		108.00	
Carpenter		50.75	
Painting woodwork		30.00	
			188.75
Material—			
Latrine fixtures		337.97	
25 gallons gasoline		5.25	
29 pounds solder		6.00	
Redwood 1 by 4, t. and g		33.20	
2 doors and frames		9.00	
Window frames and sash		11.00	
Hardware, locks, butts, etc		15.17	
			417.59
Total cost of latrine, $606.34.			
Windows in administration building, guard and dynamo rooms:			
Carpentry		14.00	
4 window frames	$5.00		
4 double sash	17.00		
Casings	4.17		
Hardware, butts, bolts, catches, etc	16.07		
Window gratings	27.40		
Paints and oils for latrine and other rooms	41.69		
8 stucco and sash brushes	1.19		
		112.52	
			126.52

Speaking tubes:			
500 feet pipe and fittings	$87.15		
14 name plates	3.80		
14 mouth pieces	3.50		
1 gross brass screws	.27		
		$94.72	
Labor		16.00	
			$110.72
Electric-light plant:			
Bed for dynamo—mason		10.00	
Material—			
6 barrels cement	$18.08		
21,600 pounds rock	14.85		
9,000 pounds sand	2.43		
		35.36	
Painting electric-light strips		24.00	
3 fan motors		44.40	
2 padlocks		2.40	
			116.16
Doors:			
Carpentry		78.75	
Mason, setting hinges		102.00	
Steel doors		945.00	
Hinge blocks		398.55	
			1,524.30
Trolley system:			
Putting up trolleys		93.75	
Scraping and painting		30.00	
12 pounds paraffine candles	$1.02		
2 casting brushes	1.00		
		2.02	
			125.77
Ammunition cranes:			
Erection of		17.00	
4 cranes		234.40	
			251.40
Stair rails:			
Labor		8.00	
Rails		10.10	
			18.10
Water supply:			
Putting up tanks, laying pipe, and pumping water		582.33	
Material—			
863 feet pipe	$99.38		
3 stop cocks	3.40		
1 gate valve	1.50		
1 strainer	1.10		
2 hosepipes	1.30		
4 hose bibbs	5.60		
3 garden valves	2.40		
10 pounds copper wire	2.50		
1 yard rubber packing	2.20		
		119.38	
Water		144.03	
			845.74
Policing:			
Labor		540.50	
Teams		38.95	
			579.45
Cement testing;			
Trier of cement		525.00	
Assistant		105.00	
12 testing molds	$36.00		
36 g. i. pans	18.00		
2 brass sieves	2.50		
		56.50	
			686.50

Photography: Chemicals, plates and paper		$15.49
Blacksmith shop:		
Sharpening tools, repairs of carts and wagons, shoeing horses, and minor repairs to concrete plant	$393.16	
Wagon work, carpentry	105.00	
		498.16
Tools and material—		
3,680 pounds Cumberland coal	23.00	
1,975 pounds assorted iron	63.70	
121 pounds toe steel	5.08	
8 kegs horseshoes	39.20	
65 pounds horseshoe nails	11.31	
½ dozen rasps	3.71	
1 combination vice	14.00	
9 shank drills	5.65	
1 ball peen hammer	.75	
1 dozen hacksaw blades	2.75	
2 wrenches	1.90	
650 carriage bolts, assorted	13.64	
72 machine bolts	3.19	
47½ pounds nuts	3.48	
15 pounds washers	1.05	
5 dozen clips	2.50	
1 pair seat springs	1.50	
5 gallons lard oil	2.50	
10 pounds borax	.90	
		199.81
Total cost blacksmith shop, $697.97.		
Stables:		
Hostler, three months	180.00	
Teamster, three months	165.00	
Veterinary surgeon's visits	20.00	
		365.00
Forage—		
26,145 pounds hay	251.25	
5,040 pounds barley	84.17	
2,600 pounds oats	50.96	
390 pounds barley	4.95	
		391.33
45 pounds harness leather	14.85	
2 dozen hamestraps	2.90	
3 brushes	3.00	
6 cakes harness soap	1.20	
1 quart ink	.15	
Buckles, snaps, and rivets	2.55	
1 dozen corn brooms	3.60	
½ dozen stable brooms	2.40	
2 chamois skins	1.20	
7 cases axle grease	12.60	
		44.45
Total cost stables, $806.78.		
Tools and material for cement finishers:		
2 dozen s. p. shovels	23.00	
3 dozen g. i. buckets	9.00	
2 drill hammers	.78	
6 barrels lampblack	29.70	
3 tubular hanging lamps	13.50	
2 railroad lanterns	1.00	
3 reflectors	1.50	
5 dozen lantern globes	6.10	
2 dozen wicks	.30	
30 gallons coal oil	6.00	
1 dozen whitewash brushes	8.00	
		98.88
Tools and material bought for carpenter shop:		
1 bench screw	.60	
1 grindstone	4.25	

Tools and material bought for carpenter shop—Continued.		
1 Fray brace	$2.00	
1 carpenter hammer	.50	
9¾ dozen files	18.78	
220 pounds manila rope	28.60	
5 gallons sperm oil	3.40	
28 lag screws	1.36	
2 quires sandpaper	.30	
5 pounds chalk	.15	
Spokes and yokes	.70	
3 pair dump-cart shafts	7.50	
1 oak reach	1.25	
168 feet oak	22.20	
		$91.59
Holidays	685.50	
Watchman	514.00	
		1,199.50
Field office:		
Overseer	500.00	
Timekeeper	425.00	
Master laborer	553.00	
Messenger	60.00	
		1,538.00
City office:		
Assistant engineer	700.00	
Clerks	625.00	
Draftsmen	1,100.00	
Messenger	180.00	
Stationery	13.44	
Telegrams	.56	
Chairs	5.45	
Telephone, rent	34.00	
Repair and cleaning of surveying instruments	10.90	
		2,669.35
		91,271.50
To which add estimated cost of work required to complete battery—		
Electric plant (installed)	$2,320.00	
Hoists (installed)	1,800.00	
Trolleys (installed)	800.00	
Superintendence, messenger, watchman, hostler, teamster (services)	300.00	
2 electric motors for hoists, at $225	450.00	
2 concrete aprons	588.00	
Painting doors, exposed surfaces, hoists, etc	200.00	
Care of slopes	100.00	
Setting base rings	150.00	
Contingencies	200.00	
		6,908.00
Total		98,179.50

RECAPITULATION.

Cost of machine-made concrete.

Framing:		
Labor	$2,878.79	
Material	2,262.51	
Taking down forms	661.18	
		$5,802.48
Concrete plant:		
Erection	2,238.39	
Running expenses	184.58	
Taking down plant	168.00	
		2,590.97
Mixing, placing, and ramming		5,215.61
6,314 barrels cement, at $3.0315		19,140.89

19,345,075 pounds (200,467 cubic feet) rock, at $1.375 per ton	$13,299.74
9,237,600 pounds sand, at $0.2696 per 1,000 pounds	2,490.46
37,884 feet water at $0.0034 per cubic foot	128.80
	48,668.95

6,314 barrels cement	28,413 cubic feet
Rock	200,467 cubic feet
Sand	92,376 cubic feet
	321,256

321,256 cubic feet loose material, equal to 224,879 cubic feet, or 8,328 cubic yards, rammed in place, making cost of concrete per cubic yard, $5.844.

Framing, per cubic yard	$0.697
Concrete plant	.311
Mixing, placing, and ramming	.626
Cement	2.298
Rock	1.597
Sand	.299
Water	.016
Total	5.844

Emplacements for sixteen 12-inch mortars.—Work was begun on the excavation and the road leading to the battery November 27, 1899. The excavation for the southern half of the battery was all in sand, that for the northern half was about half sand, the remainder being hardpan. The work of excavation was first started with 4-horse fresno scrapers, but it was found it could not be done economically by this method after a certain depth was reached, consequently the steam sand shovel, used at the pneumatic dynamite battery, was hired again and refitted to perform the work. The cars were loaded in trains of six by the steam shovel, and were then hauled by horses around to the outside of the parapet, at which point a hoisting engine with a cable was used to haul them up onto the dump. When running in a good bank of sand, this method made the cost about 6 cents per cubic yard, but shortly after the shovel was put in use hardpan was struck. It was found necessary to shovel the sand off first, then to blast the hardpan and shovel it up with the steam shovel. This was slow work, but was faster than any other method. The material in the pits and back of the magazine, which could not be reached conveniently with the steam shovel, was loaded into the cars by hand and pulled up on the dump as before explained. Considerable difficulty was experienced in controlling the sand and keeping it from blowing back into the excavation. As soon as the hardpan was struck it was used to cover the sand, and by the time the excavation was finished the sand had all been covered. It is estimated that during the work of excavation something over 2,000 cubic yards of sand were blown back into the pits. The total cost of the excavation was about $28,600, and the amount of material excavated, not counting that blown back, was about 68,300 cubic yards, making the average cost about 42 cents per cubic yard.

The excavation was practically finished in May. At the close of the fiscal year the sewers and drains throughout the battery were laid, as well as most of the foundations. Considerable ground water was found in the hardpan at the north end of the battery, and every precaution was taken to drain the ground under the foundations and to give the foundations sufficient footing to prevent unequal settlement. Eight of the gun platforms have been finished and about 10 per cent of the forms set up. All the concrete is mixed in a cubical mixer. The arrangement of the plant is essentially the same as that described for the 12-inch gun battery, the only difference being that the material is all handled by gravity until it is mixed, when the loaded concrete cars are hoisted on an elevator and trestles and run out to the desired place and dumped. Instead of a platform a large stone hopper was built to hold the reserve supply of stone. This hopper has two tracks for the measuring cars running under it, and 32 gates from which the stone can be drawn. Its capacity is 2,000 tons and 1,000 tons more can be piled up on top of the hopper. The rock wagons dump directly into the hopper, so the stone does not have to be shoveled at all. Water is supplied from the same source as explained for the 12-inch gun battery. A pipe line runs from the pump to a wooden tank set up on the parapet; from this tank it is supplied to another tank just over the concrete mixer, and to all other necessary points by pipe lines. This is simply a temporary supply; the arrangement for the permanent supply has not been determined upon, but it is thought a well can be sunk at the northern end of the battery which will supply water for all purposes except for drinking, it being too near a cemetery to be safe for this purpose.

Land for fortification purposes.—June 27, 1899, a report was submitted with a plat showing the metes and bounds of the land required for fortification purposes, and recommendation was made for its condemnation in court. At the close of the fiscal year the complaint in the condemnation suit had been filed and the answer of the owners made; the United States district attorney was preparing exceptions to the answer.

Preservation and repair of fortifications.—Under this appropriation the routine work of caring for engineer quarters and public property was carried on, mainly by fort keepers.

Money statements.

GUN AND MORTAR BATTERIES.

Emplacement for one 8-inch gun on disappearing carriage.

July 1, 1899, balance unexpended	$3,484.98
July 12, 1899, allotment	4,000.00
	7,484.98
June 30, 1900, amount expended during fiscal year	6,014.80
June 30, 1900, balance unexpended	1,470.18
June 30, 1900, outstanding liabilities	800.00
June 30, 1900, balance available	670.18

Emplacements for two 8-inch rifles on disappearing carriages.

July 1, 1899, balance unexpended		$1,591.20
July 12, 1899, allotment		5,000.00
		6,591.20
March 14, 1900, transferred to other work	$1,300.00	
March 15, 1900, transferred to other work	700.00	
		2,000.00
		4,591.20
June 30, 1900, amount expended during fiscal year		4,591.20

Emplacement for one 8-inch rifle on disappearing carriage.

July 1, 1899, balance unexpended	$4,565.72
July 12, 1899, allotment	3,000.00
	7,565.72
March 15, 1900, transferred to other work	1,700.00
	5,865.72
June 30, 1900, amount expended during fiscal year	5,865.72

Emplacements for two 5-inch rapid-fire wire-wound guns.

December 20, 1899, amount allotted	$17,473.00
May 6, 1900, transferred from other allotment	3,600.00
	21,073.00
June 30, 1900, amount expended during fiscal year	20,305.32
June 30, 1900, balance unexpended	767.68
June 30, 1900, outstanding liabilities	18.75
June 30, 1900, balance available	748.93

Emplacements Nos. 6 and 7 for 12-inch rifles on disappearing carriages.

June 30, 1899, balance unexpended	$1,667.52
June 30, 1900, amount expended during fiscal year	1,667.52

Emplacements, etc., including two 5-inch rapid-fire guns on pillar mounts.

June 30, 1899, balance unexpended	$2,285.87
June 30, 1900, amount expended during fiscal year	671.55
June 30, 1900, balance unexpended and available	1,614.32

One emplacement for a 5-inch rapid-fire gun on pillar mount.

June 30, 1899, balance unexpended	$6,000.00
June 30, 1900, amount expended during fiscal year	903.16
June 30, 1900, balance unexpended	5,096.84
June 30, 1900, outstanding liabilities	2,852.87
June 30, 1900, balance available	2,243.97

Pneumatic dynamite gun battery.

June 30, 1899, balance unexpended	$51,908.13
June 30, 1900, amount expended during fiscal year	29,045.43
June 30, 1900, balance unexpended and available	22,862.70

Mortar battery No. 1.

June 30, 1899, balance unexpended	$291.34
June 30, 1900, amount expended during fiscal year	291.34

Mortar battery No. 2.

June 30, 1899, balance unexpended	$148.53
June 30, 1900, amount expended during fiscal year	148.53

Emplacements for two 6-inch guns on disappearing carriages.

June 30, 1899, balance unexpended	$56,000.00
March 14, 1900, transferred from other allotment	1,300.00
April 20, 1900, transferred from other allotment	1,750.00
	59,050.00
June 30, 1900, amount expended during fiscal year	57,994.26
June 30, 1900, balance unexpended	1,055.74
June 30, 1900, outstanding liabilities	628.73
June 30, 1900, balance available	427.01

Electric lighting.

June 30, 1899, balance unexpended	$16,019.74
April 20, 1900, transferred to other works	1,750.00
	14,269.74
June 30, 1900, amount expended during fiscal year	12,968.78
June 30, 1900, balance unexpended and available	1,300.96

Emplacements for two 12-inch guns on disappearing carriages.

September 8, 1899, amount allotted	$114,000.00
June 30, 1900, amount expended during fiscal year	91,271.50
June 30, 1900, balance unexpended	22,728.50
June 30, 1900, outstanding liabilities	889.02
June 30, 1900, balance available	21,839.48

Emplacements for sixteen 12-inch mortars.

September 30, 1899, amount allotted	$175,000.00
June 30, 1900, amount expended during fiscal year	75,484.35
June 30, 1900, balance unexpended	99,515.65
June 30, 1900, outstanding liabilities	18,063.88
June 30, 1900, balance available	81,451.77

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

November 24, 1899, amount allotted	$40,000.00
June 30, 1900, balance available	40,000.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

June 30, 1899, balance unexpended	$2,063.68
June 9, 1900, amount allotted	1,280.00
	3,343.68
June 30, 1900, amount expended during fiscal year	1,198.54
June 30, 1900, balance unexpended	2,145.14
June 30, 1900, outstanding liabilities	65.00
June 30, 1900, balance available	2,080.14

Abstract of bids for electric lighting plants, San Francisco, Cal., received in response to advertisement of June 7, 1899, and opened by Maj. Chas. E. L. B. Davis, Corps of Engineers, United States Army, July 7, 1899.

No.	Bidder.	Plant No.1.	Plant No.2.	Plant No.3.	Total.
1	California Electrical Works	$4,350.38	$1,821.07	$3,707.39	$9,878.84
2	Parke & Lacy Co	4,055.00	1,635.00	3,455.00	9,145.00
3	Wybro-Hendy Co	3,822.00	1,642.00	3,350.00	8,814.00
4	San Francisco Iron Works	4,637.00	1,898.00	4,093.00	10,628.00

Contract awarded to Wybro-Hendy Company.

BATTERIES ON ISLANDS IN HARBOR.

Emplacement for one 8-inch rifle on nondisappearing carriage.—At the close of the last fiscal year this emplacement was completed as far as it could be, pending the arrival of the base ring.

Emplacement for one 8-inch rifle on disappearing carriage.—At the close of the last fiscal year the plans and estimates for the construction of this emplacement had been approved and an allotment of $36,000 made.

Emplacements for two 5-inch wire-wound guns.—Work was authorized December 20, 1899, with an allotment of $20,093.

WORK DONE DURING THE YEAR.

Emplacement for one 8-inch rifle on nondisappearing carriage.—The carriage having been brought to the site of the battery by the artillery the base ring was set in November, 1899. In February, 1900, some repairs were made to concrete of lookout and latrine, which had cracked from settlement of made ground, and a set of wooden steps was made leading from loading platform to parapet. The gun was mounted in February, and on May 1, 1900, the emplacement was transferred to the artillery.

Emplacement for one 8-inch rifle on disappearing carriage.—In July, 1899, the boiler and engine were set up at the quarry on Angel Island to run the crusher for getting out the stone for the concrete. The stone, as fast as crushed, was hauled to the site of the battery, a 4-horse team delivering 8 tons per day. The quantity used was approximately 2,450 tons of crushed rock and 500 tons of large stone. In August the road leading to the battery was begun and also the construction of quarters for the workmen.

The site of the battery was occupied by a reservoir of 150,000 gallons capacity, in which was stored the water supply of the garrison of the post. A new one had to be built before any work could be done on the excavation, and the work was commenced on the new tank in September. This new reservoir is situated on a knoll 300 feet in height, is 60 feet in diameter, 7 feet 6 inches deep, with 8 inches of concrete lining, both bottom and sides, and is covered with a shingle roof. It is fitted with a dividing wall 3 feet high, and has two settling chambers. The excavation, in very stiff material that would stand vertically, amounted to 891 cubic yards and cost 54½ cents per cubic yard. A 4-inch pipe line, 690 feet long, was laid to the post below where it connects with the main distribution system.

The available water supply of the island being insufficient for the use of the garrison with the extra amount required by the engineers for mixing the concrete, and for the horses and men employed in the work, a 3-inch pipe line was laid from the end of the new 4-inch line to the post wharf, and through it the quartermaster's steamer *McDowell* pumped water, brought in tanks from the city, into the new reservoir. The pumping commenced October 5, 1899. About 3,000 gallons of water per day were added to the permanent supply of the post by the development of new springs in the ravines on the southern slopes of the island.

It was expected to use the buildings near Quarry Point, erected during the construction of the 8-inch gun emplacement, but soon after commencing operations the Quartermaster's Department, on the recommendation of the department commander, decided to establish a detention camp on the island for returning volunteers who might be on infected ships. As in case of serious infection that part of the island would be rigidly quarantined, which would stop all work of construction, it was decided to construct quarters, stables, and office near the site of operations, it being cheaper than to attempt to move the old ones over the steep roadway. Smallpox breaking out in one of the regiments in camp at the Presidio, the entire regiment was sent over to the detention camp and remained several weeks, so the precaution of being independent of the old buildings proved a wise one.

As the amount of concrete was but slightly over 2,000 cubic yards, it would not have paid to put up a concrete mixing plant, and the mixing was consequently done by hand.

By the middle of October sufficient water was stored to commence concreting and a start was made with the magazine floor, and the main body of the concrete was completed in December. The finish was put on the top surfaces while the body of the concrete was still green, the same day if possible, and never later than twenty-four hours after. The result was extremely satisfactory.

A tool house 6 by 8 feet and 7 feet high, inside measurement, and a latrine were built on the left flank of the emplacement.

The shot gallery is fitted with trolleys and blocks, and a chain ammunition hoist is installed. The battery is lighted by 27 incandescent lamps from a power plant consisting of a 10-horsepower Hornsby-Akroyd oil engine and a 5.6 kilowatt dynamo. The magazine and shot gallery are surrounded by a 6-inch course of hollow tile which connects with the outer air for the purpose of ventilation. The top surfaces of exposed concrete are painted with paraffine paint and sanded; all surfaces in contact with earth are painted with two coats of paraffine paint, and the interior surfaces are whitewashed.

The battery is completed with the exception of setting the base ring, which, owing to the nonarrival of the carriage, still remains to be done.

The following is the cost of this emplacement:

Excavation	$3,056.63
Back fill	35.00
Concrete	11,435.50
Forms	2,748.00
Concrete steps and gutters	127.87
Cement finishing	999.81
Blacksmithing	571.11
Painting	137.69
Drains and ventilators	367.43
Water supply	231.33
Speaking tubes	59.53

Trolleys	$175.00
Doors	304.01
Ironwork, I-beams and bolts	658.06
Stables	523.29
Forage and supplies	2,355.54
Fireplaces	31.30
Crane	58.60
Hollow tile	149.50
Grading, sloping, and loaming	456.63
Tools	216.68
Roads	744.23
Teaming	147.00
Removing old reservoir	46.00
Building new reservoir	3,424.05
Latrine	473.62
Superintendence	2,273.34
Steamer *Yosemite*	2,276.89
Chain hoist	1,198.00
Electric-lighting plant	2,064.25
Tool house	181.84
Quarters	1,865.69
City office	254.56
Holidays	384.83
Repairs to wagon, wharf, and fencing	123.19
Spring wagon	125.00
Maintenance of quarters and policing	133.67
	40,414.67
To which add estimated cost of setting base ring	85.33
Total cost of emplacement	40,500.00

Emplacements for two 5-inch rapid-fire wire-wound guns.—The battery site was occupied by three emplacements for 8-inch converted rifles. These rifles, with their carriages, were on the ground, but not mounted, and also ten old cannon, ranging in caliber from 6 to 10 inches. These were removed by the artillery during the month of January, 1900, and on the 27th of the same month the excavation was begun. Owing to the character of the ground, rising very precipitously immediately to the rear of the new work, it was decided to mix all of the concrete on top of the old traverse, which was leveled off for the purpose. The excavation was at first confined to the limits of the main mass of concrete, and the rest of the excavation completed after the concrete mass was in place.

In January the quarrying of the stone for the concrete was started. The principal mass of the rock suitable for masonry at the quarry is overlaid with about 25 feet of earth and clayey schists. During the month of December, in a severe storm, a mass of stone and débris, estimated to be about 2,000 tons, fell and covered the available working space of the quarry almost completely. The stone which was crushed came from this mass, the refuse being carted away and spoiled in banks toward the beach. The handling of this débris increased the cost of quarrying so that the stone cost more than that taken out a few months before for the 8-inch emplacement. About one-third of the large stone used came from the quarry and the remainder was taken from a ledge of greenish stone, probably serpentine rock, near the 8-inch nondisappearing battery. It is quite tough and resists fracture very well.

The sand for the work was brought over by contract from the Presidio beach in schooner barges and landed at the foot of the parade ground, whence it was hauled to the works by four-horse teams.

The plant for mixing consisted of a platform, 15 feet by 45 feet, at an elevation of 13 feet above the highest point of the concrete. A portable gravity concrete mixer was hung on a frame leaning on two guide rails with the mouth of the machine about the elevation of the platform. This arrangement permitted the machine to be set at any point along the length of the platform. Into this the material, previously spread in two barrel batches, was shoveled, where it met two streams of water issuing from perforated pipe. The finished concrete was received at the lower end of the mixer into barrows and wheeled on runways to the works. The gravity mixer was tried as an experiment and proved very satisfactory, there being quite a saving in labor over hand mixing.

The roofs of the magazines being very flat, it was decided, in order to insure dry rooms, that it would be best to keep the large stone out of that portion of the work. As the top was neared the concrete was made somewhat richer in cement, the mixture being 1:3:6 instead of 1:3:8.

A retaining wall was built of concrete, 2 feet by 4.5 feet and 30 feet long, to the left of and slightly in front of gun No. 2, to prevent further disintegration of the original bank, and also to permit a proper dressing of front slopes, which were sown with alfalfa. The outlet of the 8-inch main of the drainage system was encased in rubble masonry. The permanent water supply is derived from the pipe line leading to the fog signal station below, the line being connected with the new reservoir built to take the place of the old one on the site of the 8-inch battery.

The rooms are lighted by twelve incandescent lamps from power generated at the electric plant in the 8-inch emplacement.

With the exception of whitewashing the interior walls, all of the engineering work is completed, and the emplacements are ready for the guns.

The following is the statement of the cost of this battery:

Excavation, 5,310 cubic yards, at 49 cents per yard		$2,593.93
Back filling		23.50
Mixer plant, for 1,296 yards concrete, at 14 cents		180.44
Forms for 1,296 yards concrete, at $1.23		1,595.06
Concrete:		
Cement, per yard, concrete placed	$1.95	
Stone, per yard, concrete placed	2.43	
Sand, per yard, concrete placed	.62	
Labor, mixing and placing	.73	
1,296 yards, at	5.73	7,426.08
Cement finishing:		
Cement, 98 barrels, at $2.93 (walls, 25 cents, and floors, 30 cents)	287.14	
Labor	472.00	
		759.14
Painting and whitewashing		103.87
Iron work:		
Ring bolts	$22.64	
Anchor bolts	189.88	
Steel beams	362.20	
		574.72
Speaking tubes		85.41
Drains and ventilation		222.00
Fireplace		18.00
Water supply		41.76
Tools		16.79

Doors, 2 double and 2 single, 6 leaves		$174.17
Macadam road		74.08
Blacksmithing		620.63
Stables:		
Labor	$217.55	
Forage	1,481.06	
		1,698.61
Grading, sloping, and loaming		161.21
Electric lighting		115.50
Steamer *Yosemite*		1,114.77
Superintendence		1,801.00
Policing		41.00
Maintenance of quarters		38.61
Miscellaneous teaming		112.00
Repair of wagons		33.92
Bridges		109.50
Retaining wall		62.47
Holidays		141.50
Sundries		153.33
Total		20,093.00

Preservation and repair of fortifications.—Under this appropriation the routine work of caring for engineer quarters and public property was carried on mainly by fort keeper.

Money statements.

GUN AND MORTAR BATTERIES.

Emplacement for one 8-inch rifle on nondisappearing carriage.

September 8, 1899, amount allotted	$300.00	
October 17, 1899, amount allotted	200.00	
		$500.00
February 18, 1900, transferred to other work		93.70
		406.30
June 30, 1900, amount expended during fiscal year		406.30

Emplacement for one 8-inch rifle on disappearing carriage.

June 30, 1899, balance unexpended	$35,894.16
February 28, 1900, transferred from other allotments	1,092.70
March 15, 1900, transferred from other allotment	2,400.00
March 15, 1900, amount allotted	2,100.00
	41,486.86
June 30, 1900, amount expended during fiscal year	40,251.53
June 30, 1900, balance unexpended	1,235.33
June 30, 1900, outstanding liabilities	1,150.00
June 30, 1900, balance available	85.33

Emplacements for two rapid-fire wire-wound guns.

December 20, 1899, amount allotted	$20,093.00
February 28, 1900, transferred to other work	999.00
	19,094.00
June 30, 1900, amount expended during fiscal year	17,059.12
June 30, 1900, balance unexpended	2,034.88
June 30, 1900, outstanding liabilities	294.45
June 30, 1900, balance available	1,740.43

PRESERVATION AND REPAIR OF FORTIFICATIONS.

June 30, 1899, balance unexpended	$850.00
June 9, 1900, amount allotted	800.00
	1,650.00
June 30, 1900, amount expended during fiscal year	650.00
June 30, 1900, balance unexpended	1,000.00
June 30, outstanding liabilities	110.00
June 30, 1900, balance available	890.00

BATTERIES ON NORTH SIDE OF BAY.

At the close of the last fiscal year the condition of the work was as follows:

Emplacements for two 8-inch rifles on nondisappearing carriages.—Engineering work was completed except setting the base rings.

Emplacements for three 12-inch rifles on nondisappearing carriages.—This battery was completed in 1897, but will require some repairs to top surfaces to prevent dampness in magazines.

Emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts.—At the close of the last fiscal year this battery was under way and in the following month was carried forward as far as it could be to advantage without the metal work of the balanced-pillar mounts.

Emplacements for two 12-inch rifles on disappearing carriages.—At the close of the last fiscal year the engineering work was completed with the following exceptions: Setting base rings, hanging trolleys and some of the doors, finishing one loading platform, finishing a part of inside walls of magazines, and installing the electric-lighting plant. Guns and carriages had not been received.

WORK DONE DURING THE YEAR.

Emplacements for two 8-inch rifles on nondisappearing carriages.—The carriages arrived in July, and a written agreement was entered into with R. D. Noble and A. Desouza, of Sausalito, Cal., to move them from the wharf to the site of the battery for the sum of $585. The work of moving them was completed in December, 1899. In October the guns arrived and, under written agreement with George Davis & Sons, of San Francisco, Cal., they were moved from the point where they were landed by the Quartermaster's Department to the battery site for the sum of $420, the work being completed in December, 1899.

The base rings were set in January and the battery turned over to the artillery May 5, 1900.

Emplacements for three 12-inch rifles on nondisappearing carriages.—The elevator shafts as built proved too small to accommodate the standard pattern of ammunition trucks issued by the Ordnance Department, which difficulty was overcome by some slight alterations in the trucks.

The protective coating of the top surfaces of the concrete was a mixture of pure asphalt and sand and was put in by an expert. It was supposed to be waterproof, elastic, and not liable to erosion under the blast of the gun. It has proved unsatisfactory, having many wide cracks and allowing some leakage in one of the magazines. The bituminous rock in use here is a natural product and is of excellent quality as a road covering, but seems to require the constant kneading of traffic to keep the cracks closed up. It is proposed to remove this asphalt covering, to roughen the surface of the concrete, and to resurface with a 6-inch layer of granolithic concrete consisting of 1 part cement, 2½ parts of sand, and 5 parts fine gravel, the work to be done soon.

Emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts.—The site for this battery is on a ridge too narrow to permit the construction of a battery of three guns, as was at first intended. An allotment of $25,000 was made in May, 1899, a figure under the estimates, for which reason it was directed to omit for the present the installation of the electric-lighting plant. Early in the fiscal year, the excavation was completed, foundations and drains laid, the road to the site of the battery built, and gravel and sand for the concrete gathered and stored. Work has since been suspended, as it has progressed as far as it can until the ironwork of the balanced-pillar mounts is received.

Emplacements for two 12-inch rifles on disappearing carriages.—The original project for this site contemplated a battery of 12-inch rifles on lifts, subsequently modified, so far as concerns the mounts, to disappearing carriages.

In August, 1898, a project was substituted for constructing a battery of two 12-inch guns at this point, and an allotment of $60,000 was made the same month for its construction.

Owing to the peculiarly sheltered position of this battery provision had only to be made against direct penetration. This was amply provided for and all concrete roof surfaces so shaped as to deflect any impinging shot. This favorable condition suggested the possibility of raising the magazines so as to dispense with lifts and greatly facilitate the service of ammunition. This arrangement was adopted, the passageway being at the terreplein level, the floor of the magazines being 18 inches lower and that of the projectile rooms 1 foot lower. In rear of the terreplein an earthen slope with concrete stairs leads down to the level of a covered way upon which all the service rooms open.

Upon removing the forms from the magazine in November, 1898, it was discovered that the concrete had cracked in several places, the chief cracks appearing in the long passage extending in rear of the powder and shot rooms, there being four of these cracks, extending the entire length of the passage.

The soil at the site of the battery is essentially alluvial. Embankments of earth and clay were built on this to form the old earthen battery. The new battery is founded partly on natural ground and partly on the made ground of the old battery, and all parts of the concrete have not settled equally. It is evident that the floor of the passage and the thin wall were places of weakness, where inequality of settlement of the masses in front and in rear of passage produced rupture.

It was deemed best to defer further work on this concrete mass until the winter rains were over and final settlement had taken place. Particular attention was given to the drainage of emplacement No. 3; it is drained directly to the front of the beach. A tunnel was driven under the old parapet, a 6-inch pipe laid, and the tunnel then filled up. The permanent water supply of the battery comes from the ravine to the northwest. A concrete settling basin has been built in this ravine, from which a pipe carries the water to the battery. A hydrant is placed in rear of each emplacement; the water is under good serviceable pressure.

In constructing the aprons in front of the guns, as they rest partly upon the natural ground and partly upon fill, the old flat iron traverse circles were distributed through the concrete in such a way as to resist the effects of unequal settlement. No evidences of settlement or cracking have so far appeared.

The electric-lighting powerhouse, a concrete structure with slate roof, is located behind high hills and is concealed from view of ships.

The work of finishing the battery was commenced after the rainy season was over, and by July, 1899, was practically completed, except the installation of the electric-lighting plant and the setting of the base rings. The cracks in the concrete were filled with cement mortar and the floors and walls were finished in the ordinary manner. The upper surface of the concrete covering of the rooms was finished with asphalt laid as follows: First was placed a layer of hot asphaltic cement one-eighth inch thick; next a layer of asphaltic cement and sand about 2¼ inches thick, and last a layer of hot asphaltic cement one-eighth inch thick with hot sand spread over it. This protective coating was laid with great care, but there are indications that it is not waterproof and the subject of its removal and the substitution of some other covering will receive careful consideration.

The electric-lighting plant was installed, tested, and accepted during February, 1900.

During October the carriages arrived. A written agreement was made with Jas. A. McMahon, of San Francisco, Cal., for moving the carriages from the landing to the site of the batteries, for $2,947. The contractor delayed working, thinking the weather would be more favorable, and it was April before the first barge load was delivered, an attempt to land in the previous month proving unsuccessful. During May the remaining parts of the carriages were successfully delivered, and in June the base rings were set, and recommendation made that the battery be turned over to the artillery.

The following is a detailed statement of the cost of the battery:

Excavation, 15,857 cubic yards at 42+ cents		$6,741.05
Mixer plant, for 5,126 yards concrete, at 31+ cents		1,594.49
Forms, for 5,126 yards concrete, at 68+ cents		3,529.71
Concrete:		
Cement, per barrel, $2.99; per yard concrete placed	$2.32	
Stone, per yard, $2.28; per yard concrete placed	1.38	
Sand and gravel, per yard, 46 cents; per yard concrete placed	.51	
Labor, mixing and placing, per yard, 46 cents; per yard concrete placed	.48	
5,126 yards, at	4.69+	24,055.33
Cement finishing:		
Labor (including asphalt roof, $733.18); floors, $0.4014 per square yard; walls, $0.1915 per square yard	2,383.50	
Cement	1,260.29	
		3,643.79
Painting and whitewashing		230.60
Ironwork:		
Ringbolts	200.00	
Anchor bolts	547.54	
Steel beams	664.48	
		1,412.02

Trolleys, 4 lifts		$403.04
Speaking tubes, 475 linear feet (24 whistles), at 9+ cents		46.78
Drains and ventilation, 2,030 linear feet, at 24+ cents		494.89
Fireplaces, 4, at $20.45		81.80
Water supply:		
At quarters	$479.82	
At battery	350.10	
		829.92
Tools		21.90
Doors, 4 double, 6 single; total, 14 leaves, at $43.53		609.42
Cranes, 2, at $32.85+		65.71
Roads	492.20	
Macadamizing, 38 cents per square yard	281.76	
		773.96
Blacksmithing		1,481.16
Stables:		
Labor	504.16	
Forage	3,450.94	
		3,955.10
Grading, sloping, back filling		305.55
Repair of dock		623.90
Hoisting engine for dock (running expenses)		465.00
Latrine, 4 closet seats		612.84
Power house		741.20
Electric-light plant		2,002.50
Steamer *Yosemite* (without repairs of April and May, 1900)		2,723.15
City office		1,891.06
Superintendence, including janitor, watchman, cement tester, and field office expenses		4,353.66
Sundries		1,218.54
Moving carriages from Lime Point Wharf to beach		2,947.00
Setting base rings		189.50
Total		68,044.57

Preservation and repair of fortifications.—Under this appropriation the routine work of caring for engineer quarters and public property was carried on, mainly by fort keeper.

Money statements.

GUN AND MORTAR BATTERIES.

Emplacements for two 8-inch rifles on nondisappearing carriages.

Allotments:		
September 8, 1899	$500.00	
October 17, 1899	400.00	
November 16, 1899	185.00	
November 28, 1899	420.00	
		$1,505.00
June 30, 1900, amount expended during fiscal year		1,505.00

Emplacements for two 5-inch rapid-fire guns.

June 30, 1899, balance unexpended	$22,725.28
August 31, 1899, transferred to other work	3,913.00
	18,812.28
June 30, 1900, transferred from other allotment	96.95
	18,909.23
June 30, 1900, amount expended during fiscal year	3,915.98
June 30, 1900, balance unexpended and available	14,993.25

Emplacements for two 12-inch rifles on disappearing carriages.

June 30, 1899, balance unexpended	$3,800.83
August 31, 1899, transferred from other allotments	3,913.00
November 16, 1899, amount allotted	8,000.00
	15,713.83
May 6, 1900, transferred to other work	3,600.00
	12,113.83
June 30, 1900, transferred from other allotments	162.95
	12,276.78
June 30, 1900, amount expended during fiscal year	8,922.35
June 30, 1900, balance unexpended	3,354.43
June 30, 1900, outstanding liabilities	2,100.86
June 30, 1900, balance available	1,253.57

PRESERVATION AND REPAIR OF FORTIFICATIONS.

June 30, 1899, balance unexpended	$1,218.44
June 9, 1900, amount allotted	4,400.00
	5,618.44
June 30, 1900, amount expended during fiscal year	994.77
June 30, 1900, balance unexpended	4,623.67
June 30, 1900, outstanding liabilities	146.00
June 30, 1900, balance available	4,477.67

Abstract of bids for moving gun carriages and base rings, received in response to advertisement of November 25, 1899, and opened by Maj. Charles E. L. B. Davis, Corps of Engineers, United States Army, December 5, 1899.

No.	Bidders.	Address.	Price.
1	J. R. Pool and W. J. Burt	San Francisco, Cal	$5,000
2	Elias Evensen Otterbeck	do	6,900
3	George Davis	do	4,945
4	Jas. A. McMahon	do	2,947
5	Cotton Bros. & Co	Oakland, Cal	4,700
6	Thomas Thomson	San Francisco, Cal	5,200
7	Saxton-Hoadly Contracting Co., Incorporated	do	9,162

Contract awarded to Jas. A. McMahon.

SHELTERS FOR LEWIS RANGE FINDERS.

The plan proposed by the local board of 1898 called for 13 range finders of type A and 11 of type B. At the close of the last fiscal year the condition of the work was as follows:

On the south side of the bay.—Lewis range finders, type A: One shelter completed; concrete work of three others completed so far as to be ready for the roof. Forms for concrete of a fourth were in place.

Emergency range finders, type B: Piers near emplacements 10 and 16 completed.

At another point a temporary pier for Lewis range finder was built and a shed set up over the pier. A concrete pier, with parapet around it, was built for an emergency range finder.

On the north side of the bay.—Lewis range finders, type A: Excavation was made for two piers and shelters and concrete carried up as far as it could be done until the receipt of the roofs. As it became known that the board on location of position finders, convened by orders of the Adjutant-General's Office, would recommend many changes of sites, work was suspended May 18, 1899, pending the receipt of this board's report.

WORK DONE DURING THE YEAR.

After the sites selected by the new board were known it was found that two of the old system of range finders could be utilized and they were therefore completed, one on the north side and the other on the south side of the bay.

The new project called for 16 range finders of type A, leaving 14 yet to be built. With the funds on hand it was estimated that 6 could be built, as follows:

On islands in harbor	1
North side of bay	2
South side of bay	3
Total	6

Islands in harbor.—Excavation was commenced in March and the work was completed in May. The work was carried on in connection with that going on at the same time at the rapid-fire battery.

The following is the cost of this shelter:

Excavation, including grading	$145.00
Concrete, with cement finish, complete	310.55
Carpentry	222.43
Painting	28.80
Steel roof	512.24
Cost shelter complete	1,219.02

North side of the bay.—One of the partially completed range-finder shelters that could be utilized for the new system was completed.

No work has been done on the two shelters yet to be built, as it was thought to be more economical to carry on the work in connection with other work, and it is the intention to perform the work when the repairs to the ridge battery are undertaken in the near future.

South side of the bay.—Work was resumed in November, 1899, when it was found that one of the shelters ready for the roof could be utilized for the new system and the building was completed, the roof being put on by the contractor who furnished the roofs.

No other work was done until March, 1900, when a commencement was made on two stations. The excavations were completed and some of the forms put up during March, but concrete work was not started until the latter part of April when a force of men could be spared from the work going on at the 5-inch rapid-fire battery. Both stations were then completed, the steel roofs being put on by employees of the Engineer Department.

There is enough money available to build one more station and work will commence as soon as the 15-pounder rapid-fire battery is begun, in the near future, as it can be done so much more economically in connection with other construction work.

The following is the cost of these two shelters:

Clearing sites	$10.00
Excavation	114.00
Forms	214.75
Concrete work	662.39
Sewers	52.15
Steel roofs	974.00
Setting roofs	145.83
Ceiling, fences, steps, etc	249.42
Doors, windows, and shutters	116.27
Plastering and pointing	148.10
Paraffine painting	4.00
Back fill	39.80
Painting woodwork	58.52
Policing	50.00
Total for two shelters	2,839.23
Cost of one selter	1,419.62

Money statement.

June 30, 1899, balance unexpended		$11,745.04
June 30, 1900, transferred to other works	$259.90	
June 30, 1900, amount expended during fiscal year	8,785.61	
		9,045.51
June 30, 1900, balance unexpended		2,699.53
June 30, 1900, outstanding liabilities		174.68
June 30, 1900, balance available		2,524.85

Supplies for coast defenses.—On June 7, 1900, an allotment of $1,000 was made from this appropriation to enable this office to furnish material required to be supplied for the service of the coast artillery during the fiscal year 1901, under the provisions of General Order 66, Adjutant-General's Office, current series.

Money statement.

June 7, 1900, amount allotted	$1,000.00
June 30, 1900, balance available	1,000.00

Torpedo station, pay of keeper and incidental expenses.—During the year the keeper was employed in attending to his usual duties about the station and making such small repairs as were required.

Money statement.

July 1, 1899, balance available at end of last fiscal year	$571.93
January 11, 1900, amount allotted	600.00
	1,171.93
June 30, 1900, amount expended during the year	759.50
July 1, 1900, balance unexpended	412.43

Casemate No. 1.—No work was done during the fiscal year, and by Department letter of June 11, 1900, the allotment was withdrawn.

Money statement.

July 1, 1899, balance on hand	$900.00
June 16, 1900, deposited to the credit of the Treasurer United States	900.00

Torpedo shed.—During the early part of the fiscal year the racks, which had never been put into the shed, were erected. This completed the shed.

Money statement.

July 1, 1899, balance on hand		$697.28
September 30, 1899, deposited to the credit of the Treasurer United States	$216.77	
June 30, 1900, expended during the fiscal year	480.51	
		697.28

Additional cable tank at torpedo station.—This work, which was in progress at the beginning of the fiscal year, was completed in October, 1899. The new tank was completed, which afforded ample storage for all the cable on hand, the pump moved, and the supply and waste pipes rearranged so as to accommodate the new tank.

Money statement.

July 1, 1899, balance on hand		$774.43
October 30, 1899, deposited to the credit of the Treasurer United States	$38.47	
June 30, 1900, expended during the fiscal year	743.96	
		774.43

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3 W.

DEFENSES OF MOUTH OF COLUMBIA RIVER, OREGON AND WASHINGTON.

Officers in charge, Capt. William C. Langfitt, Corps of Engineers, to June 21, 1900; Capt. William W. Harts, Corps of Engineers, since that date; assistant, Lieut. Amos A. Fries, Corps of Engineers, to September 29, 1899; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers.

At the beginning of the present fiscal year the condition of the work was as follows:

Four emplacements for 10-inch rifles on disappearing carriages.—These emplacements were entirely completed, and, with their guns and carriages, turned over to the artillery on March 16, 1898.

Two emplacements for 10-inch rifles on disappearing carriages, A. R. F.—These emplacements had been practically completed, the work then remaining to be done being the sodding of the parapet slopes, removal of elevated railroad tracks, hanging of doors, etc.

Emplacements for eight 12-inch mortars.—The mortar battery was fully completed, the carriages being mounted, and was turned over to the commanding officer on January 17, 1899. The mortars had been received at the close of last fiscal year, but not mounted.

Electric-light station, site No. 1.—This had been finished, and the plant, consisting of one 56¼ kilowatt dynamo, with switchboard and fittings, belt driven by a 65-horsepower engine, to which steam is furnished from an 80-horsepower locomotive boiler, installed.

Mining casemate, site No. 1.—This had been completed, including 750 feet of gallery, with all shelves, tables, etc., in place.

Torpedo storehouse.—The storehouse had been completed, and all submarine mining material, except cables, stored in it.

Cable tanks.—The two cable tanks, with covering sheds, overhead traveler, and railroad connection, were fully completed.

Two emplacements for 8-inch rifles on disappearing carriages.—This battery was entirely completed and guns and carriages mounted.

Emplacement for one 8-inch rifle on experimental disappearing carriage.—All construction work for it had been finished in May, 1898. The wiring for electric lights has been done. The experimental carriage, model 1894, has not yet been received. The rifle for this emplacement was delivered on January 24, 1898.

These three 8-inch emplacements and the ordnance were turned over to the commanding officer July 16, 1898.

Electric-light station, site No. 2.—Work on this had been completed, ready for the electric-light plant, which had been purchased, but its installation not begun.

Mining casemate, site No. 2.—The casemate proper, with gallery, was finished in March, 1898. To accommodate the oil engine, transformer, and storage battery required to be installed, an allotment of $1,885 had been made, together with an unexpended balance of $1,414.76, for the construction of an addition for the purpose above noted. At the beginning of the fiscal year only excavation for the site had been begun.

Two emplacements for 15-pounder rapid-fire guns, site No. 1.—An allotment of $12,000 had been made for this. Material for construction was received, but no work had been done.

Two emplacements for 6-inch rifles, disappearing carriages, model 1898, site No. 1.—An allotment of $59,000 had been made for this battery. The only work done up to the close of last fiscal year was to receive materials and store them.

Two emplacements for 6-inch rifles, disappearing carriages, model 1898, site No. 2.—The final plans for this battery had been approved on June 14, 1899, when an additional allotment of $38,600 was made. A provisional allotment of $19,000 had previously been made, making the total cost $57,600. Work of clearing and grubbing of the site had begun, and sand and crushed rock received and stored.

Two emplacements for 15-pounder rapid-fire guns, site No. 2.—The revised plans and estimate were approved with the 6-inch battery plans on June 14, 1899, and an additional allotment made in the sum of $7,110, a provisional allotment of $3,500 having been made on February 23, 1899. The full amounts of sand and crushed rock required for the concrete work has been received and stored but no construction work begun.

Platform for 15-inch smoothbore gun.—The platform for this had been built in old fort and the gun and carriage mounted.

OPERATIONS DURING THE FISCAL YEAR 1900.

Ten-inch gun battery, six emplacements.—Under date of November 6, 1899, alternate plans, with estimates, were submitted for the construction of a connection in rear of traverses between guns of emplacements 1–4, to allow ammunition to be taken from one platform to the next. The heavier construction was approved November 15, 1899, the cost, $1,325, to be paid from available funds from appropriation for "Gun and Mortar Batteries," mouth of Columbia River. This work was completed in accordance with the approved plan.

All construction work on the two A. R. F. emplacements, Nos. 5 and 6, was finished in the early part of the fiscal year. The loading platforms were completed in accordance with the original drawings. Modifications in the carriages have since been made by the Ordnance

Department, which require some changes to be made in the platforms. One 10-inch disappearing carriage, A. R. F., model 1896, W. A., No. 2, was received on April 18. No additional alterations having been made in these carriages, the necessary changes in platforms 5 and 6 were made by cutting away the concrete, to allow a free space for floor plates of 18 instead of 12 inches. The two 10-inch rifles for these emplacements were received in November, 1899. To transport the guns and carriages to the emplacements a railroad track was constructed, connecting with existing rail system and that of the Astoria and Columbia River Railroad. The 10-inch carriage and the two guns were taken over this track, unloaded on the parapet, and there turned over to the artillery. The base rings were set soon after arrival of the carriage, and the work of mounting was followed up at once by the artillery and completed at the end of the fiscal year, including the gun. The carriage for emplacement No. 6 has been shipped but not received. The two A. R. F. emplacements, 5 and 6, were turned over to the commanding officer June 28, 1900.

Emplacements for eight 12-inch mortars.—The eight mortars were mounted by the artillery in July.

The drainage systems of the 10-inch and mortar batteries being unsatisfactory, as depending upon a wooden box drain to keep down the level of the lake into which these sewers empty, plans and estimate were submitted on February 3, 1900, for proposed changes in the drainage systems to prevent flooding of the emplacement by back water from the lake, in case of failure of the wooden box drain, by connecting the sewers of these batteries with that of the 6-inch battery, which empties into Columbia River. These plans were approved under date of February 23, 1900, the cost, $2,000, to be paid from available balance from appropriation for "Gun and Mortar Batteries," two 10-inch emplacements. This work has been nearly completed. The high level of the saturation line of the ground during the rainy season prevented this work being done until the summer months.

Mining casemate, site No. 1.—The inside of the casemate and engine rooms were painted white, and a Sturtevant blower provided. This blower will be run from a countershaft driven by the oil engine. All parts of the countershaft and fittings are made, ready to install at any time when needed.

Torpedo storehouse.—The steel roof trusses were painted black and the ceilings and inside walls white. The doors and windows were also painted.

Two emplacements for 15-pounder rapid-fire guns, site No. 1.—The construction of these was entirely completed, including the wiring for electric lights. The necessary water and drainage connections were put in and the battery inclosed by a fence. In the construction of this battery 756 cubic yards of concrete was laid, and for the parapet fill 3,384 cubic yards of sand was dumped. The base castings for the pillar mounts have not yet been received from the Ordnance Department, nor mounts and guns. These emplacements were turned over to the commanding officer on June 28, 1900.

Two emplacements for 6-inch rifles, disappearing carriages, model 1898, site No. 1.—At the close of last fiscal year only the work of assembling materials had been done. This battery is now completed, with the exception of the wiring of the emplacements and the installation of the storage battery. This has been received and its installation begun. The construction of this battery was greatly delayed, first, by the delay of two months in the delivery of the cement, and then in the rejection of 3,273 barrels of one brand when delivered. Concreting was at last begun in the latter part of October and practically completed in January. Four thousand three hundred and forty-two cubic yards of concrete entered into the construction of this battery, and for the parapet fill 12,036 cubic yards of sand was used. The usual provision was made for tile draining around the foundation and in rear of the battery, and sewer connections made with all sumps and drains. A main 12-inch sewer, emptying into the river, was put in and will be used for the 10-inch and mortar batteries as well, as previously adverted to. The battery was inclosed by a fence. Both carriages were received and the base rings set. All parts of the carriages were unloaded from the cars and put on the loading platforms for the artillery, by whom they were mounted. The guns have not yet been received. These emplacements were turned over to the commanding officer on June 28, 1900.

In considering the electric lighting of the 6-inch emplacements it was found that the general system of lighting of the 10-inch and 6-inch batteries could be greatly improved by certain changes and the rearrangement of the storage battery installed for the 10-inch battery. Report, with plans and estimate, showing the proposed changes was submitted on March 12, 1900, and returned approved on the 27th of the same month. The necessary supplies have been ordered and partly delivered. Work of installation is in progress.

The water supply at this locality has always been more or less unsatisfactory and precarious, making the supply for the gun batteries very uncertain and subject to interruption and failure. To remedy this and provide a constant supply for the gun batteries and central electric station recommendations were made for the construction of independent water-supply systems by means of wells and separate pipe lines. These recommendations were approved under date of May 23, the estimated cost, $1,500, to be paid from available balance from appropriation "Gun and Mortar Batteries," act of July 7, 1898, two emplacements for 10-inch guns. Work on this has been commenced, but not completed,

Battery commanders' stations, type A.—In compliance with sixth indorsement on letter of Maj. J. P. Story, Seventh Artillery, president of the board on location of position finders, approximate estimate of cost of the range-finder stations recommended by that board, in report accompanying letter above mentioned, together with approximate estimate of cost of necessary conduits, etc., was submitted on November 24, 1899, for approval. These recommendations were approved under date of December 9, 1899, but, owing to the small balance of funds available for that purpose, it was impossible at that time to provide for the complete installation of the fire-control system for the defense of the Columbia River. Allotments were made, however, for one battery commander's station for the 10-inch battery to cost $2,729, and one for the 8-inch battery to cost $1,666, from the appropriation for "Gun and Mortar Batteries," for installation of range and position finders, act of July 7, 1898. Work on the station for the 10-inch battery, which was given extra protection of concrete on account of its exposed position, was begun in March and completed in May. In connection with this station a concrete stairway was constructed on the inner slope of the parados and a concrete walk on top of the parados, from the stairway to the station.

For the 8-inch battery, work on the station was begun in April and completed in May.

Range and position finders, type B.—From the appropriation for "Gun and Mortar Batteries," act of July 7, 1898, there was allotted under date of June 27, 1899, the sum of $225 for the mounting of bases for type B, range and position finders, one-half of this sum for one site and the other half for another site. One mounting was installed at the first site with a wooden stairway leading to it, and at the second site one mounting, duplicate base, both at the places designated for them.

Electric-light station, site No. 2.—In this was installed one 16-brake horsepower Hornsby-Akroyd oil engine and one Westinghouse 11½-kilowatt, 125 volt-multipolar, compound-wound dynamo, with switchboard and all necessary instruments, and this plant is in operation for direct lighting of the three 8-inch emplacements. A 58-element, type F 11, storage battery, in lead tanks, has been purchased and is on the ground ready for installation in emplacement No. 2 of the 8-inch battery.

Mining casemate, site No. 2.—The addition to the casemate of an oil engine and dynamo room, which was authorized last year, was completed. This room is 10 by 17 feet and adjoins and is directly connected with the casemate room. Particular care was exercised in its construction to provide ample drainage and ventilating facilities. The casemate itself which, since its construction, had been very damp and wet, was overhauled at the same time to stop leaks and condensation. The work on the casemate and addition was completed in November, and since that time both rooms have been entirely dry and free from moisture. A small Sturtevant blower, to be run from the oil engine, has been provided for this casemate.

Two emplacements for 6-inch rifles, disappearing carriages, model 1898, site No. 2.—The excavation for foundation was completed in September, 8,765 cubic yards having been removed. Concreting was begun shortly after completion of excavation and was practically finished in January. Three thousand eight hundred and fifty-nine cubic yards of concrete was used in construction. In the rear of the battery a macadam roadway was made, connecting with the 15-pounder battery. These emplacements, with their drainage and water systems, chain ammunition hoists, trolley rails, speaking tubes, etc., are completed, with the exception of the wiring of the rooms and the installation of the electric-light plant. This battery was designed to accommodate duplicate oil engine and dynamo, electric light and power plant, doing away with all outside wiring and the storage battery.

The oil engines are to be 7 B. H. P. Hornsby-Akroyd, and the dynamos General Electric Company's 4½ kilowatt, bipolar. The contract has been let for these and all necessary instruments, fittings, wire, etc., for delivery before July 30, 1900.

The carriages for the two emplacements were received on May 8, unloaded from steamer, taken to end of railroad track and there turned over to the artillery. The base rings were set at once and the carriages mounted by the artillery at the close of the fiscal year. The guns have not yet been received. These emplacements were turned over to the commanding officer on June 28, 1900.

Two emplacements for 15-pounder rapid-fire guns, site No. 2.—This battery, on which work was commenced in August, was also fully completed, except for the wiring of the rooms. The excavation was very heavy and amounted to 7,755 cubic yards of stiff clay, while the amount of concrete laid was only 723 cubic yards. A macadam roadway in rear of battery connects with the 6-inch emplacements. The 15-pounder battery will be lighted from the electric-light plant in the 6-inch battery. The base castings, mounts, or guns have not yet been received. These emplacements were turned over to the commanding officer on June 28, 1900.

Repairs to fortifications.—From the appropriation "Preservation and Repair of Fortifications," act of March 3, 1899, the following allotments were made on August 8, 1899, for prevention of dampness in magazines: Mortar battery, $825; 8-inch battery, $975.

In the mortar battery, cracks in the pit aprons had extended through the concrete to the shell rooms and magazines, causing leaks after heavy rains, and, besides, condensation caused much dampness. To stop the leaks shafts were sunk into the parapet fill over the cracks and tunnels run in, tracing the cracks as far as they could be seen, cutting them out and thoroughly covering them with several coats of asphalt. All cracks over the magazines were thus stopped but one, which, during the heaviest rain, would cause leaks. In the shell rooms the leakage has not been entirely overcome, owing to surface cracks in the aprons which application of oil would not stop.

Since the system of ventilation was put in in September there has not been the slighest indication of condensation in any of the rooms or passages, and, except for occasional leaks, they have been entirely free from moisture. For the whole mortar battery five sewer-pipe ventilators, three 10-inch and two 8-inch, with seven inlets, were carried from the ceiling of the rooms through the concrete to the surface of the fill.

The three 8-inch emplacements were also subject to dampness from condensation and leaks, and more so than any of the other works. The allotment of $975 was expended in trying to overcome dampness, and was successful so far as condensation was concerned, but not in stopping the leaks. The front vertical wall of the parapets had not been plastered, and in order to do this it was necessary to dig a trench along the parapet below the elevation of the ceiling I-beams. This stopped the leaks from this part of the walls, but through the top of the parapet and the loading platforms considerable water would come through. To stop this, the top surfaces were covered with two coats of linseed oil, or all that the concrete would take. This worked fairly well until this spring, when sudden changes of temperature caused the joints to open.

Care of electric-light plants.—Under the allotment made on June 9, 1899, from the appropriation for "Preservation and Repair of Fortifications," act of May 7, 1898, $360 for one fortification and $300 for another, the storage batteries were regularly charged about once every week, and the electric-light plants, wiring, etc., cared for. For the care of the electric-light plants during the fiscal year ending June 30, 1901, there was allotted, under date of June 9, 1900, from the appropriation "Preservation and Repair of Fortifications," act of May 25, 1900, the sums of $600 and $150, respectively, for these fortifications.

Storing and caring for torpedo material.—An allotment of $125 was made on April 17, 1899, for the drying and storing of searchlights and dynamos. Of the two searchlight outfits the projectors, dynamos, and engines, controllers, switch boards, and few minor parts were stored in tin-lined packing boxes, and this completes the putting away of all class A material according to instructions. All torpedo material has been kept in good order in the storehouse, which is always dry and free from moisture. For the semiannual inspections, which were made on November 28 and May 5, all submarine mining materials were thoroughly overhauled and found to be in very good order. At the May inspection one of the sealed packing boxes, containing the five operating boxes, was opened. The contents were found to be in such perfect condition that it was deemed unnecessary and inadvisable to open others for the purpose of completing the inspection.

In the last Annual Report it was noted that drum No. 311, multiple cable, India Rubber and Gutta Percha Insulated Company, was, on testing, found to have one defective core. The facts having been reported, this drum was turned over to the Quartermaster for shipment to the above firm on July 12, 1899. On August 11, a new drum, same number, of multiple cable was received back. All submarine cables have been stored in the cable tanks. Some of the cables were tested for insulation at the May inspection by using storage-battery current and found good. There was forwarded from Willets Point, N. Y., on May 26, and received on June 18, 1900, a shipment of torpedo materials, comprising all of the articles enumerated in the List of Materials for Defense of Mouth of Columbia River, submitted to the Chief of Engineers August 26, 1899, to be supplied from "depot," with a few exceptions. This material has all been unpacked and stored in the torpedo storehouse, but as yet no steps taken for its permanent storage.

Two emplacements for 6-inch rapid-fire guns, site No. 1.—In letter of May 4, 1899, instructions were received to prepare plans, with estimate, for the construction of two additional emplacements for 6-inch B. L. rifles on disappearing carriages. The drawings, with estimate, were submitted on June 1, 1899. Under date of June 14, 1899, notification was received that action upon the plans submitted would be deferred for the present, the particular mount to be furnished for these guns not having yet been definitely determined by the Ordnance Department. On December 2, 1899, the Chief of Engineers authorized the construction of emplacements for two 6-inch rapid-fire guns in accordance with the approved project. A provisional allotment of $15,000 was made to be applied to the construction of these, with the understanding that no portion of it be expended until receipt of further instructions, as the details of the mount had not yet been sufficiently perfected to permit the designing of the emplacements. No work has been performed under this allotment.

One emplacement each for 15-pounder rapid-fire gun at site No. 1 and site No. 2.—The Chief of Engineers, under date of May 16, 1900, called for detailed plans and estimate for the construction of two emplacements for 15-pounder rapid-fire guns, on balanced-pillar mounts, in accordance with the approved project. Such detailed plans, with estimate, were submitted on June 5, 1900, and received back on the 16th of the same month approved. The sums of $5,450 and $4,840 were allotted for the construction of these emplacements at sites Nos. 1 and 2, respectively.

No work has been performed under these allotments, but material has been advertised for looking to early commencement of construction.

General remarks.—For description of mixer plants see Report of Chief of Engineers, 1897, Part I, pages 757–761, and for details of construction and cost of work see Report of 1899, Part I, pages 1000–1003.

The materials used were, as previously, obtained under sealed proposals, and the work done by the United States by hired labor.

All emplacements so far constructed are electrically lighted, or the plants necessary for this are on hand or have been ordered and will be installed as soon as received.

In the unloading and mounting of guns and carriages every possible assistance has been given the artillery in their work.

There were no unusual conditions met with in the works under construction, and the methods described in the last Annual Report were as a rule closely followed. The cost of the work will differ but slightly, although as the work of fortifications progresses details of cost become more difficult to ascertain, on account of the various and numerous allotments under which work is carried on at the same time by one working force.

The only departure in finishing off the works worth mentioning is that of the top surface of the concrete parapets, which was divided into stones 3 to 4 feet square, with a joint three-eighths inch wide by 2½ inches deep between them, which was afterwards filled with hot asphalt. The loading platforms were made in a similar manner, and, to judge from four months' experience, it is believed will prevent surface cracks and leaky emplacements, particularly under loading platforms, where asphalt cover over rooms is not always permissible.

These works of defense have been in the immediate charge of G. B. Hegardt, assistant engineer, who has rendered most valuable and efficient service.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1899, balance unexpended		$161,963.94
June 27, 1899, amount allotted		225.00
December 2, 1899, amount alotted (provisionally)		15,000.00
December 9, 1899, amount allotted		4,395.00
June 16, 1900, amount allotted		10,290.00
		191,873.94
February 21, 1900, deposited to credit of Treasurer of the United States	$14.00	
June 30, 1900, amount expended during the fiscal year	148,739.48	
		148,753.48
July 1, 1900, balance unexpended		43,120.46
July 1, 1900, outstanding liabilities		10,329.05
July, 1900, balance available		32,791.41

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1899, balance unexpended	$3,582.76
June 30, 1900, amount expended during the fiscal year	3,463.60
July 1, 1900, balance unexpended	119.16
July 1, 1900, outstanding liabilities	119.16

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1899, balance unexpended	$1,323.65
August 8, 1899, amount allotted	1,800.00
June 9, 1900, amount allotted	750.00
	3,873.65
June 30, 1900, amount expended during fiscal year	2,752.89
July 1, 1900, balance unexpended	1,120.76
July 1, 1900, outstanding liabilities	67.02
July 1, 1900, balance available	1,053.74

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3 X.

DEFENSES OF PUGET SOUND, WASHINGTON.

Officer in charge, Capt. Harry Taylor, Corps of Engineers; assistant, Lieut. Meriwether L. Walker, Corps of Engineers; Division Engineer, Col. Samuel M. Mansfield, Corps of Engineers.

Emplacements for four 10-inch and two 12-inch guns on nondisappearing carriages.—At the beginning of the year these emplacements were practically completed. There was a little grading to be done to smooth off the slopes, the whitewashing to be done, the metal work to be painted, and the electric-light plant to be put in.

During the year nearly all of the whitewashing and painting has been done. Some of the rooms having proved damp, the earth abutting against the walls through which the moisture came was excavated, the outside walls cleaned, plastered, and waterproofed with an alum-and-lye wash, a facing of hollow brick laid against the wall, and the earth refilled. This work has greatly lessened the dampness.

The two 12-inch guns and three of the 10-inch guns in the battery were mounted during the year and the 12-inch guns were each fired three rounds with full service charges. The firing had no apparent effect on any of the work in the battery.

The cast-iron gear wheels of the ammunition winches have proved to be too light for service and they will be replaced by bronze ones having greater strength.

Money statement.

July 1, 1899, balance unexpended	$1,178.19
June 30, 1900, amount expended during fiscal year	1,170.64
Deposited to credit of Treasurer of the United States	7.55

Emplacements for four 10-inch guns on disappearing carriages.—At the beginning of the year these emplacements were practically completed. With funds allotted for preservation and repair some refilling was done along the front of the emplacements where the earth, which was loosely filled in at the time the emplacements were built, had settled, subsurface drains were put in to carry away the water from the front of the battery, and the slopes were reseeded where necessary.

This battery is almost perfectly dry throughout, only a very few slightly damp spots having developed.

The lighting system has not yet been put in.

The funds allotted for the construction of these emplacements were exhausted prior to June 30, 1899, and the funds used during the fiscal year are accounted for under "Preservation and Repair of Fortifications."

Emplacements for five 10-inch and two 12-inch guns on nondisappearing carriages.—At the beginning of the year the excavation for the concrete work had been made, the drainage system partly put in, the foundations of the entire work laid, the gun platforms partly built, and part of the retaining walls built. The total amount of concrete put in prior to the beginning of the year was 5,526 cubic yards.

The battery was completed during the year, with the exception of a small amount of whitewashing and finishing of the walls, painting, and general cleaning up. During the year the principal work was grading in front of the battery, which was done by contract, and placing concrete, which was done by hired labor. There were 43,560 cubic yards of grading done at a cost of 27 cents per cubic yard, and 11,783 cubic yards of concrete placed. The concrete was of three grades according to the use to be made of it. No. 1 concrete consisted of 1 part cement, 2 parts sand, and 4 parts gravel; No. 2 concrete, 1 part cement, 3 parts sand, and 6 parts gravel, and No. 3 concrete, 1 part cement, 4 parts sand, and 8 parts gravel. No. 1 was used only for pavements and steps, No. 2 for the gun platforms, and No. 3 for the balance of the work. The average cost of No. 1 concrete was $1.295 per square yard, laid 3¼ inches thick; of No. 2 was $5.966 per cubic yard, and of No. 3 $5.282, every expense connected with the concrete, including the forms, being included, except the first cost of the plant. The plant used on this work was shown by drawings and photographs in the Annual Report for 1899.

The cost of this work was increased by the long haul up the high bluff upon which the work is situated. No trouble was experienced with the foundations. Tile drains are laid around the outside of the bottom of all concrete work against which earth is filled, and all such walls are waterproofed with an alum-and-lye solution. As far as can be detected the battery is absolutely dry.

Details in regard to this battery are given under site No. 3 in the report of Lieut. M. L. Walker, Corps of Engineers, which follows:

Money statement.

July 1, 1899, balance unexpended	$48,537.57
Allotted since	35,000.00
	83,537.57
June 30, 1900, amount expended during fiscal year	72,104.30
July 1, 1900, balance unexpended	11,433.27
July 1, 1900, outstanding liabilities	1,765.92
July 1, 1900, balance available	9,667.35

Contracts in force during year.

Name of contractor: Samuel Hadlock.
Date of contract: October 31, 1898.
Date of approval: December 9, 1898.
Date of commencement: November 1, 1898.
Date of completion: November 30, 1899.
Contract completed: November 10, 1899.

Name of contractor: Hale & Smith Company.
Date of contract: July 31, 1899.
Date of approval: August 12, 1899.
Date of commencement: August 22, 1899.
Date of completion: March 11, 1900.
Extended to April 11, 1900.
Contract completed: April 11, 1900.

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, in response to advertisement dated June 27, 1899, for 132,000 cubic yards of excavating; opened July 17, 1899.

No.	Name and address of bidder.	Quantities.	Separate lots.		If awarded both lots.		
			Bid.	Amount.	Bid.	Amount.	Total.
1	Hale & Smith Co., Portland, Oreg.:[1]	*Cub. yds.*					
	Lot M	70,000	......	....	27	$18,900	$35,640
	Lot G	62,000	......	....	27	16,740	
2	Rydstrom & Goerig, Seattle, Wash.:						
	Lot M	70,000	43	$30,100	37	25,900	48,840
	Lot G	62,000	38	23,560	37	22,940	
3	Cascade Construction Co., Portland, Oreg.:						
	Lot M	70,000	47½	33,250	45	31,500	50,100
	Lot G	62,000	32½	20,150	30	18,600	
4	Peter M. Coyne, Port Townsend, Wash.:						
	Lot M	70,000	47	32,900	47	32,900	55,220
	Lot G	62,000	36	22,320	36	22,320	
5	C. P. Church, Portland, Oreg.:						
	Lot M	70,000	30	21,000	30	21,000	36,500
	Lot G	62,000	27½	17,050	25	15,500	
6	E. C. McClanahan and Dennis Conroy, Seattle, Wash.:						
	Lot M	70,000	60	42,000	59	41,300	63,620
	Lot G	62,000	37	22,940	36	22,320	

[1] Recommended.

Mortar battery No. 1.—At the beginning of the year this battery was practically completed. With funds allotted for preservation and repair and the small balance on hand at the beginning of the year, the slopes which had washed during the heavy winter rains were repaired as well as possible, and drains made so as to prevent future washing. The slopes of this battery have now become settled so that they can be thoroughly repaired and given true grades, with some prospect of remaining in shape.

This battery is almost perfectly dry throughout, only one slightly damp spot showing anywhere. The roofs of all rooms and passages are covered with asphalt and the entire walls are protected by an outside layer of hollow brick.

The lighting system has not yet been put in.

Money statement.

July 1, 1899, balance unexpended	$897.75
Allotted since	7.28
	905.03
June 30, 1900, amount expended during fiscal year	896.51
Deposited to credit of Treasurer United States	8.52

Mortar battery No. 2.—At the beginning of the year the plans for this battery had been prepared and approved, and advertisements for the excavation had been issued, but no work had been done. The battery has been practically completed. At the end of the year the only work remaining to be done is putting up the trolleys, finishing up the ements, whitewashing and painting, putting in the electric-lighting n, and general cleaning up. During the year 65,861 cubic yards of excavation were made under contract, 22,926 cubic yards of back fill made under informal agreement, and 10,290 cubic yards of concrete laid by day labor. The foundations of this battery are in hardpan and are thoroughly drained by tile drains; the walls are protected by a layer of hollow brick wherever they come in contact with the earth, and the roofs of all rooms and passages covered with earth are protected by asphalt. The battery is perfectly dry throughout.

Details in regard to this battery are given under site No. 3 in the report of Lieut. L. M. Walker, Corps of Engineers, which is hereto appended.

Money statement.

July 1, 1899, balance unexpended		$156, 903. 51
June 30, 1900, amount expended during fiscal year		153, 944. 38
July 1, 1900, balance unexpended		2, 959. 13
July 1, 1900, outstanding liabilities	$1, 566. 18	
July 1, 1900, amount covered by uncompleted contracts	830. 43	
		2, 396. 61
July 1, 1900, balance available		562. 52

Contracts in force during year.

Name of contractor: J. B. C. Lockwood.
Date of contract: June 22, 1899.
Date of approval: July 5, 1899.
Date of commencement: July 5, 1899.
Date of completion: August 19, 1899.
Contract completed: August 19, 1899.

Name of contractor: Hale & Smith Company.
Date of contract: July 31, 1899.
Date of approval: August 12, 1899.
Date of commencement: August 22, 1899.
Date of completion: November 11, 1899.
Extended to December 11, 1899.
Further extended to January 15, 1900.
Contract completed: January 15, 1900.

Name of contractor: Pacific Bridge Company.
Date of contract: October 31, 1899.
Date of approval: November 16, 1899.
Date of commencement: as required by Engineer Officer in charge.
Date of completion: December 31, 1900.

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, in response to advertisement dated September 11, 1899, for furnishing sand and gravel or broken stone; opened September 26, 1899.

Items.	Quantities.	1. Pacific Bridge Co., Seattle, Wash.				2. Smith, Wakefield & David, Seattle, Wash.				3. Rydstrom & Goerig, Tacoma, Wash.	
		Separate items.		If awarded contract for all.		Separate items.		If awarded contract for all.		If awarded contract for all.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
	Cu. yds.										
Sand	10,000	$1.25	$12,500	$0.55	$5,500	$0.93	$9,300	$0.93	$9,300	$0.68	$6,800
Small gravel or broken stone	700	.80	560	.55	385	1.00	700	.93	651	.68	476
Large gravel or broken stone	20,000	.80	16,000	.55	11,000	.93	18,600	.93	18,600	.68	13,600
Total					16,885				28,551		20,876

Emplacements for three 8-inch guns on disappearing carriages.—Plans of this battery were prepared and approved, and work commenced during the year. A wharf with sand and gravel bunkers was built by contract, and a contract made for clearing the site of the battery and making the excavation. The clearing has been completed and the excavation about four-fifths completed; a tramway from the wharf to the site of the battery located, and the grading done by hired labor. Part of the plant for carrying on the work is on the ground. The cement for the concrete has been purchased and part of it received, the steel roof beams purchased and received, and much other preliminary work done. The battery will be completed about January 1, 1901. Details of this work are given under site No. 4, in Lieutenant Walker's report, hereto appended.

Money statement.

June 30, 1900, amount allotted		$103,000.00
June 30, 1900, amount expended during fiscal year		43,299.27
July 1, 1900, balance unexpended		59,700.73
July 1, 1900, outstanding liabilities	$6,333.29	
July 1, 1900, amount covered by uncompleted contracts	12,354.17	
		18,687.46
July 1, 1900, balance available		41,013.27

Contracts in force during year.

Name of contractor: Pacific Bridge Company.
Date of contract: October 31, 1899.
Date of approval: November 16, 1899.
Date of commencement: As required by Engineer Officer in charge.
Date of completion: December 31, 1900.

Name of contractor: W. F. Nelson.
Date of contract: April 9, 1900.
Date of approval: April 19, 1900.
Date of commencement: May 3, 1900.
Date of completion: August 3, 1900.

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, in response to advertisement dated February 26, 1900, for clearing and excavating; opened March 19, 1900.

Articles.	Quantities.	1. W. F. Nelson, Seattle, Wash.		2. J. A. Bailey, Seattle, Wash.		3. Horace A. Middaugh, Seattle, Wash.		4. Hale & Smith Co., Portland, Oreg.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing .....acres..	5	$185.00	$925.00	$50.00	$250	$200.00	$1,000	$100.00	$500
Cord wood...cords..	75	2.25	168.75	1.40	105	2.00	150	1.00	75
Excavation.cu. yds..	17,500	.39	6,825.00	.65	11,375	.98	17,150	.50	8,750
Total	....	....	7,918.75	....	11,730	....	18,300	....	9,325

Emlpacements for two 6-inch rapid-fire guns, Brown segmental pattern, on navy mounts.—Plans were prepared for a battery of two 6-inch guns on disappearing carriages, and part of the plant purchased and other preliminary work done and arrangements made for carrying on the work. The plans prepared will require material modificaion to adapt them to the new style of mount, and, as no information t hand in regard to the requirements of the mounts, nothing has been done toward such modification. No work has been done and none can be done until the plans are received.

Money statement.

July 1, 1899, balance unexpended	$1,604.87
Allotted since	15,000.00
	16,604.87
June 30, 1900, amount expended during fiscal year	511.36
July 1, 1900, balance unexpended and available	16,093.51

Emplacements for 5-inch rapid-fire guns on balanced-pillar mounts.—There are two emplacements at each sites 1, 2, and 3. The two emplacements at each sites 1 and 3 were completed during the year as far as practicable until the mounts are received. On account of the exhaustion of the funds when work was in progress at site No. 2, work on this battery was suspended before the battery was completed, and for economical reasons was not resumed after a new allotment was made. The battery can be completed in a short time when work is resumed. The two emplacements at each site are identical in plan, but the battery at site No. 2 will cost about twice as much as that at site No. 3. This is accounted for partly by the inaccessible location at site No. 2 and partly by the fact that at site No. 3 a skilled force, which had been employed in the construction of the 10-inch and 12-inch gun battery and the mortar battery at that site was available, as was also the plant which had been used. The work at site No. 2 suffered many vexatious delays, which also added to the cost.

Details in regard to these batteries are given in Lieutenant Walker's report, hereto appended, under the respective sites.

Money statements.

SITE NO. 1.

July 1, 1899, balance unexpended	$10,000.00
Allotted since	3,000.00
	13,000.00
June 30, 1900, amount expended during fiscal year	12,516.07
July 1, 1900, balance unexpended	483.93
July 1, 1900, amount covered by uncompleted contracts	204.27
July 1, 1900, balance available	279.66

SITE NO. 2.

July 1, 1899, balance unexpended	$9,021.76
Allotted since	6,850.00
	15,871.76
June 30, 1900, amount expended during fiscal year	12,022.58
July 1, 1900, balance unexpended and available	3,849.18

SITE NO. 3.

July 1, 1899, balance unexpended	$9,859.27
June 30, 1900, amount expended during fiscal year	5,930.17
July 1, 1900, balance unexpended	3,929.10
July 1, 1900, amount covered by uncompleted contracts	56.03
July 1, 1900, balance available	3,873.07

Contract in force during year.

SITES 1 AND 3.

Name of contractor: Pacific Bridge Company.
Date of contract: October 31, 1899.
Date of approval: November 16, 1899.
Date of commencement: As required by Engineer Officer in charge.
Date of completion: December 31, 1900.

Emplacements for three 5-inch rapid-fire guns, Brown segmental pattern, on navy mounts.—Plans and estimates were prepared and approved for this battery and an allotment made for the construction of two of the emplacements. The materials for use in the construction of this battery were nearly all purchased and other preparations made for carrying on the work, but no construction work was done. The two emplacements for which an allotment has been made will be completed during the coming fiscal year.

Money statement.

June 30, 1900, amount allotted	$16,000.00
June 30, 1900, amount expended during fiscal year	627.56
July 1, 1900, balance unexpended	15,372.44
July 1, 1900, outstanding liabilities	136.80
July 1, 1900, balance available	15,235.64

Contract in force during year.

Name of contractor: Pacific Bridge Company.
Date of contract: October 31, 1899.
Date of approval: November 16, 1899.
Date of commencement: As required by Engineer Officer in charge.
Date of completion: December 31, 1900.

Emplacements for 15-pounder rapid-fire guns on balanced-pillar mounts.—Plans and estimates were prepared and approved and allotments made for two emplacements each at sites 4 and 5. The materials for use in the construction of these emplacements were nearly all purchased and other preparations made for carrying on the work, but no construction work was done. These emplacements will all be completed during the coming fiscal year.

Plans and estimates were prepared for four additional emplacements at site No. 4.

Money statements.

SITE NO. 4.

June 30, 1900, amount allotted	$8,500.00
June 30, 1900, amount expended during fiscal year	187.84
July 1, 1900, balance unexpended	8,312.16
July 1, 1900, outstanding liabilities	136.80
July 1, 1900, balance available	8,175.36

SITE NO. 5.

June 30, 1900, amount allotted	$8,500.00
June 30, 1900, amount expended during fiscal year	187.84
July 1, 1900, balance unexpended	8,312.16
July 1, 1900, outstanding liabilities	136.80
July 1, 1900, balance available	8,175.36

Armament.—At the beginning of the year three 10-inch and two 12-inch nondisappearing gun carriages, and sixteen 12-inch mortar carriages had been received and mounted, and three 10-inch and two 12-inch guns, and four 10-inch disappearing carriages received. During the year there were received six 10-inch guns, thirty-two 12-inch mortars, one 12-inch and five 10-inch nondisappearing gun carriages, and twelve 12-inch mortar carriages. Two 12-inch and three 10-inch guns were mounted on nondisappearing carriages, three 10-inch guns on disappearing carriages, and twelve mortars on their carriages. One 12-inch and four 10-inch nondisappearing carriages, four 10-inch disappearing carriages, and four 12-inch mortar carriages were mounted. One 10-inch nondisappearing gun carriage and eight 12-inch mortar carriages were partly mounted. Six 12-inch mortars were transferred to the emplacements ready for mounting. Two 12-inch and three 10-inch guns mounted on nondisappearing carriages, three 10-inch guns mounted on disappearing carriages, twelve 12-inch mortars mounted, two 10-inch guns not mounted, four 12-inch mortars not mounted, one 10-inch disappearing gun carriage mounted, one 10-inch nondisappearing carriage partially mounted, and four mortar carriages mounted were turned over to the artillery garrisons during the year. Since the above ordnance was turned over, the artillery has mounted one 10-inch gun on disappearing carriage and four mortars.

Money statement.

July 1, 1899, balance unexpended	$10,660.22
Allotted since	5,000.00
	15,660.22
June 30, 1900, amount expended during fiscal year	11,914.21
July 1, 1900, balance unexpended	3,746.01
July 1, 1900, outstanding liabilities	2.55
July 1, 1900, balance available	3,743.46

Cable tank and torpedo storehouse.—Plans for a storehouse for storing torpedo material were prepared and approved, a contract let for the construction of the house, and the building partially completed. This building will be completed early in the fall, and the material on hand transferred to it.

A storage tank for the cable on hand was prepared during the preceding fiscal year by throwing a dam across a small creek. This was intended as a temporary expedient for quickly caring for the cable, but it serves the purpose that a more expensive tank might. At some future time it may be necessary to roof it over.

Money statements.

STOREHOUSE.

June 30, 1900, amount allotted	$9,000.00
June 30, 1900, amount expended during fiscal year	2,576.84
July 1, 1900, balance unexpended	6,423.16
July 1, 1900, amount covered by uncompleted contracts	5,143.89
July 1, 1900, balance available	1,279.27

CABLE TANK.

July 1, 1899, balance unexpended	$194.37
June 30, 1900, amount expended during fiscal year	194.37

Contracts in force during year.

STOREHOUSE.

Name of contractor: Pacific Bridge Company.
Date of contract: October 31, 1899.
Date of approval: November 16, 1899.
Date of commencement: As required by Engineer Officer in charge.
Date of completion: December 31, 1900.
Name of contractor: M. J. Carkeek.

Date of contract: March 19, 1900.
Date of approval: March 31, 1900.
Date of commencement: April 19, 1900.
Date of completion: August 19, 1900.

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, in response to advertisement dated January 24, 1900, for constructing a concrete and brick storehouse, opened February 23, 1900.

Name of bidder.	For—	Amount.
M. J. Carkeek	Constructing storehouse	$6,829

Preservation and repair of fortifications.—With allotments made for the purpose the batteries at sites 1 and 2 were cared for, slopes which had washed during the winter were worked over, roads improved, whitewashing and painting done, and other miscellaneous work done.

With an allotment made for the purpose some of the rooms of the battery at site 1 were waterproofed, as reported above under emplacements for four 10-inch and two 12-inch guns.

Allotments were made in June, 1900, for additional miscellaneous repairs of the batteries at sites 1 and 2, and for the preservation and repair of the torpedo material on hand.

Money statements.

SITE NO. 1.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	1,000.00

SITE NO. 1 (WATERPROOFING).

June 30, 1900, amount allotted	$300.00
June 30, 1900, amount expended during fiscal year	300.00

SITE NO. 1 (MISCELLANEOUS REPAIRS).

June 30, 1900, amount allotted	$2,200.00
July 1, 1900, amount available	2,200.00

SITE NO. 2.

July 1, 1899, balance unexpended	$1,000.00
June 30, 1900, amount expended during fiscal year	1,000.00

SITE NO. 2 (MISCELLANEOUS REPAIRS).

June 30, 1900, amount allotted	$1,300.00
July 1, 1900, amount available	1,300.00

SITE NO. 4 (CARE, ETC., OF TORPEDO MATERIAL).

June 30, 1900, amount allotted	$1,000.00
July 1, 1900, amount available	1,000.00

Road betterment, retrimming and regrading slopes, and for planting a wind-break at 10-inch and 12-inch gun battery at site No. 1.—An allotment was made in June, 1900, for the purpose above specified. No work was done under this allotment before the end of the year. It will be completed early in the fall.

Money statement.

June 30, 1900, amount allotted	$5,000.00
July 1, 1900, amount available	5,000.00

Road construction and retrimming and regrading slopes of mortar battery No. 1.—An allotment was made in June, 1900, for the purpose above specified. No work was done before the end of the year. This work will be completed early in the fall.

Money statement.

June 30, 1900, amount allotted	$3,700.00
July 1, 1900, amount available	3,700.00

Clearing, grubbing, grading, and seeding certain areas at site No. 1.—An allotment was made in June, 1900, for the work as above specified, in accordance with the recommendations of a board of officers. No work was done before the end of the year. The work will be completed early in the fall.

Money statement.

June 30, 1900, amount allotted	$2,934.00
July 1, 1900, amount available	2,934.00

Fire commanders' stations.—Estimates were submitted and allotments made for fire commanders' stations at each sites 1, 2, and 3. No construction work was undertaken during the year. Some additional working drawings will have to be prepared. These will be completed and the work done early in the fall.

Money statements.

SITE NO. 1.

June 30, 1900, amount allotted	$4,946.00
July 1, 1900, amount available	4,946.00

SITE NO. 2.

June 30, 1900, amount allotted	$2,370.00
July 1, 1900, amount available	2,370.00

SITE NO. 3.

June 30, 1900, amount allotted	$5,000.00
July 1, 1900, amount available	5,000.00

New light-house station at Admiralty Head, Wash.—The act of March 3, 1899, making appropriation for fortifications authorized an expenditure of not to exceed $8,000 from the funds appropriated by that act for moving or reconstructing the light-house station at Admiralty Head, Wash. The old light-house being unfit for moving, plans and specifications for a new station were prepared by the Light-House Department. These plans and specifications were turned over to the Engineer Department and an allotment made for the work.

Money statement.

June 30, 1900, amount allotted	$8,000.00
July 1, 1900, amount available	8,000.00

Supplies for coast defenses.—Under authority of the act of May 25, 1900, an allotment was made for the purchase of approved supplies for the artillery garrisons. No requisitions were received before the end of the year.

Money statement.

June 30, 1900, amount allotted	$500.00
July 1, 1900, amount available	500.00

Construction of steel-hull tug.—Under authority granted March 10, 1898, a contract had been made during the preceding fiscal year for a steel-hull tug for use in connection with the river and harbor works and works of defense in the district. The tug was completed and accepted early in the year and has since been in service. This tug has been of very great service in facilitating and cheapening the construction work carried on since she was built, as shown by the work at site No. 3 and the bar survey at Grays Harbor made during June, 1900. At site No. 3 a gun battery was constructed with sand and gravel for the concrete, delivered by contract at the Government wharf. These materials were delivered on small scows and frequently at times when it was inconvenient to unload them, and during the entire time the supply was irregular and uncertain, causing annoying delays to the work. A mortar battery was afterwards constructed at the same site. The sand and gravel for the concrete for this battery were delivered on Government scows at the contractor's wharf and the towing done by the Government tug. The mixing of the concrete for the two batteries was done by the same plant, but the haul from the mixing plant to the mortar battery was longer than to the gun battery, and the method of hauling not quite so economical. But comparing the best month's work on the gun battery with the best month's work on the mortar battery, a saving of 64 cents per cubic yard is shown in favor of the mortar battery. The expenses for the tug for the time are charged against the mortar battery, and the saving is over and above these expenses. The saving is due to the larger scows on which the material was brought, making them more economical to unload, and to the regularity and certainty of the supply, enabling plans to be made ahead as to the amount of work to be done. In June, 1900, the tug was used for making a survey of the bar at Grays Harbor. Two years ago a tug was hired for this purpose at a rate of $100 per day, the same having to be paid whether the tug was actually used or not. The tug, although the best adapted to the purpose of any that could be hired, was not very satisfactory. This year a much more satisfactory survey was made in much less time. The tug has also been used in inspecting the various works on Puget Sound, her use enabling the same inspections to be made in one day that took three days to make without her.

Money statement.

July 1, 1899, balance unexpended	$15,457.50
June 30, 1900, amount expended during fiscal year	15,457.50

Sites.—Condemnation proceedings for the purpose of acquiring title to sites 4 and 5 had been held during the preceding year, but the title had not been passed to the United States at the beginning of the year. The necessary legal proceedings were completed, the title passed, and the amount of the award paid into court during the year.

Money statement.

June 30, 1900, amount allotted	$38,600.00
June 30, 1900, amount expended during fiscal year	37,978.70
June 30, 1900, deposited to credit of Treasurer United States	621.30

REPORT OF LIEUT. M. L. WALKER, CORPS OF ENGINEERS.

SITE NO. 1.

Emplacements for four 10-inch and two 12-inch guns on nondisappearing carriages.—This work was done under contract by the Pacific Bridge Company, of Portland and San Francisco. Date of contract, July 28, 1897. Contract completed, March 28, 1899.

Owing to dampness in many of the rooms and galleries, much interior wall finishing and all whitewashing of walls and painting of metal work had to be deferred.

As proposed in the last annual report, the earth was removed from the face of the wall in front of all magazines and shell rooms. This wall was plastered smoothly, waterproofed with a solution of lye, alum, and cement, and then a course of hollow brick was placed against it, draining into the tile pipe around the foundations. The earth was then replaced and thoroughly rammed down. The dampness has not entirely disappeared, but the condition of all rooms except five improved so that finishing, painting, and whitewashing were completed. The excepted five rooms give promise of ultimate improvement.

In the original project no provision was made for other than a dirt road in rear of battery. Owing to the character of the material and the excessive dampness it was found necessary to ask for an allotment for a gravel roadway and also for trimming up the slopes where they have washed badly. This money is now available, and the work will be done before the next rainy season.

The cast-iron gear wheels of the winches of the ammunition lifts having proved unequal to even light service, allotment was asked and made to replace them with bronze wheels. This will be done in the near future. The bronze hinge pins of the steel doors also proved defective and there is now money allotted for replacing them with steel pins, which will be done.

Plans and estimates for lighting this battery electrically were submitted during the year. The plant—oil engine and dynamo—is duplicated and contained entirely within the battery. No storage battery is used.

There are twelve rooms in this battery having earth overhead, and these have proved exceedingly damp. Allotment of $300 was made for experiment upon one of them. The earth was removed to the foundations, the exterior of the room plastered smoothly, and waterproofed with a solution of lye, alum, and cement. Hollow brick were then placed over the entire surface, draining into the tile pipe around the foundations and the back fill made. The room is now comparatively dry, and the experiment promises success.

Emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts.—Although allotment for this battery was made on November 28, 1898, no work was done until July 25, 1899, it being hoped that the cylindrical castings to be set in the platform might arrive. They did not, however, so work was commenced as above, and was done by day labor.

A small wharf was constructed, running out to the low-water line, and upon this all materials were landed and the concrete was mixed by hand. From the wharf materials were hoisted to the site of the battery by means of a stiff-leg derrick operated by a 16-horsepower Lidgerwood single-drum engine. Sand and gravel were purchased under contract and delivered by the Government steamer and scows. Cement for this work was furnished from an excess at site No. 3, but a charge for it is introduced in the cost of the concrete to make the information complete.

One thousand dollars of the allotment for this battery was used for the purchase of old plant from the contractors at site No. 2.

One thousand one hundred and sixteen and four-tenths cubic yards of concrete were placed, at an average itemized and total cost per yard as follows:

Sand and gravel	$1.432
Cement	2.182
Forms	1.054
Mixing and placing	1.431
Plant and installation	1.119
Purchase of old plant	0.896
Superintendence	2.124
Total cost per cubic yard	10.238

This cost per cubic yard includes all items for labor and materials which are chargeable against concrete.

The original estimate for this battery was $12,000, and an additional allotment of $3,000 was asked for and obtained December 16, 1899. This was rendered necessary by large advances in prices of all materials and labor and by delays to work, owing to difficulties of obtaining steel beams and of supplying concrete materials in such an exposed location during the winter season.

Only whitewashing walls, painting metal work and setting castings in platforms remains to be done to complete this battery.

It is the intention, should there be sufficient funds, to surface the roadway in rear of the battery with gravel.

Provision is made so that, if desired, this battery can be lighted electrically from the plant in the heavy gun emplacements.

Work was discontinued on this battery March 31, 1900. The rooms in this battery are perfectly dry.

Mounting guns and carriages.—The remaining 10-inch rifle and its carriage arrived during the year, completing the emplacement of heavy ordnance for the completed work. Three of the 10-inch rifles and the two 12-inch rifles were removed from the beach to their emplacements by contract with the San Francisco Bridge Company, the mounting then being done by hired labor. All carriages were landed upon the wharf about 1¼ miles from the emplacements. Arrangement was made with the Pacific Bridge Company, whereby we loaded and unloaded carriage material, and they furnished rolling stock and did the hauling. Under this agreement all carriages were moved to the emplacements. Three 10-inch and two 12-inch carriages have been completely assembled, and the base ring of the remaining 10-inch carriage has been set. Assembling this last carriage and moving and mounting thereon its gun were, by orders, left for the troops to accomplish. A battery of troops took station here September 5, 1899, and, under authority from the Chief of Engineers, all ordnance property was, upon February 2, 1900, turned over to the ordnance officers of the post.

The two 12-inch rifles which were in a fire upon the beach were tested by the Ordnance Department May 17–19, 1900, by firing from each three solid shot with full service charge. There is no indication that they were at all damaged. These guns are both mounted upon altered gun-lift carriages.

The total cost of moving and mounting the guns and carriages at this site is as follows:

Amount paid Pacific Bridge Company	$284.00
Amount paid San Francisco Bridge Company	1,950.00
Labor	3,177.02
Tools, supplies, etc	800.91
Total	6,211.93

The troops are now engaged in assembling the remaining 10-inch carriage and mounting thereon its gun.

Position finders.—Estimates were prepared and submitted April 11, 1900, for erecting towers for position finders at the fire commander's and battery commander's stations for this post. Allotment was made for the fire commander's tower, but no work has yet been done. Further estimates and plans for two battery commanders' stations have been ordered submitted.

Emplacements for sixteen 12-inch mortars.—During spare time from other work a survey was made of the site of the projected mortar battery at this place, and plans and estimates were prepared. These were forwarded to the Chief of Engineers June 25, 1900.

SITE NO. 2.

Emplacements for seven 10-inch guns on disappearing carriages.—Four of these emplacements are completed, and plans and estimates for the remaining three were forwarded to the Chief of Engineers June 25, 1900.

The completed emplacements were built, under contract dated August 24, 1897, by Messrs. Maney, Goerig & Rydstrom. Contract was completed upon December 15, 1898.

The only work done upon these emplacements since acceptance from the contractors is some whitewashing and painting, and trimming up and seeding of slopes. This was all done during the preceding fiscal year.

The earth roadway here having proved a failure, allotment was asked and obtained for a gravel roadway. This work will be done before the next rainy season.

The cast-iron gear wheels of the winches for the ammunition lifts having proved unequal even to light service, allotment was asked and obtained to replace them with bronze wheels. This work will be done in the near future.

The bronze hinge pins of the steel doors also proved defective, and there is now money allotted for replacing them with steel pins, which will be done.

Plans and estimates were submitted on September 22, 1899, for lighting electrically this battery, the plant—oil engine and dynamo—being duplicated and entirely contained within the battery, No storage battery is to be used.

The omission of the blast-proof aprons in front of the guns was authorized by the Chief of Engineers.

The rooms in this battery are perfectly dry.

Emplacements for sixteen 12-inch mortars.—This battery was built, under contract dated February 28, 1898, by Messrs. Maney, Goerig & Rydstrom, and the contract was completed upon March 14, 1899.

Since acceptance this battery has been whitewashed again throughout and all metal work cleaned and given another coat of black paint.

Plans and estimates were submitted during the year for trimming and seeding the slopes, constructing a gravel roadway in rear, replacing bronze hinge pins with steel, and for a duplicate electric-lighting plant. Allotment has been made for all except the electric plant, and the work will be done in the near future. This battery is dry except for a leaky place in pit No. 2, and it is hoped that this can be traced to a defective joint in the water pipe.

Emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts.—Work was delayed upon this battery on account of nonarrival of cast-iron cylinder for the platform, but was finally begun August 12, 1899, without these cylinders having arrived, and was done by day labor.

Gravel and sand are collected from the beach, conveyed to the mixer house, and the concrete is mixed by the plant purchased from Messrs. Maney, Goerig & Rydstrom, and which was used by them for the two preceding works. From the mixer the concrete is conveyed to the site of the battery in bottom dump-cars drawn by a small Porter locomotive. A swinging track over the battery allows the concrete to be deposited in any desired spot.

This work has been subjected to many vexatious delays, due to the nonarrival of steel beams and accidents to the plant, and is hence still in an uncompleted state, there being about 400 cubic yards of concrete still to go in. The first estimate was for $12,000. Additional allotments are $3,000 upon December 16, 1899, and $3,850 upon April 19, 1900. The delays and advances in prices of labor and all materials are responsible for increased cost. Work was stopped on this battery March 15, 1900, on account of lack of funds, but will be resumed shortly and completed before January 1, 1901, with the funds now on hand.

Position finders.—Estimates were prepared and forwarded for constructing towers at the fire commander's and battery commanders' stations and allotment made for the fire commander's tower, but no work done. Further estimates and plans for the two battery commanders' stations have been ordered submitted.

Mounting guns and mortars.—At the commencement of the fiscal year sixteen mortar carriages had been partially assembled. During the year sixteen 12-inch mortars, four 10-inch disappearing carriages, and four 10-inch rifles were moved to their respective emplacements. Twelve mortars were mounted and their carriages completely assembled. Four 10-inch disappearing carriages were completely assembled and three 10-inch rifles mounted. The remaining four mortars and one rifle were ordered left for the troops to mount.

A detachment from the battery at site No. 1 took station at this post in the latter part of September, 1899. By authority of the Chief of Engineers all ordnance property was, upon February 12, 1900, turned over to the post ordnance officers. The work upon guns and carriages was all done by hired labor, and all plant had to be purchased, there being none at hand. Material for the mortar battery was moved about one-half mile and for the gun battery about one mile.

The cost is as follows:

Labor	$10,365.16
Materials for railroad	1,148.25
Tools, supplies, etc	1,601.84
Total	13,115.25

The troops have completed mounting the remaining 10-inch rifle and four 12-inch mortars.

SITE NO. 3.

Emplacements for five 10-inch and two 12-inch guns on nondisappearing carriages.—This work has been done by day labor, and no unusual difficulties have been encountered except the height of the hill to be surmounted and the difficulty of obtaining water and slowness of the contractors in supplying sand and gravel. Clearing was commenced upon August 13, 1898, and excavation for the foundations a few days thereafter. Owing to difficulties concerning supply of water concrete was not laid until May 10, 1898, and upon June 30, 1898, 5,526 cubic yards of concrete had been placed.

During the fiscal year the work has been brought to such a stage that only a small amount of whitewashing, finishing of walls and painting, putting in the blast-proof aprons, and the general cleaning up of the site remains to be done.

Eighteen thousand four hundred and fifty-six cubic yards of material were excavated by day labor from the foundations of the battery, at a cost of $0.696 cents per cubic yard. This material is hardpan and was all handled with barrows. The quantity given above includes all drainage trenches.

Forty-three thousand five hundred and sixty cubic yards of material were excavated by contract upon the superior slope and put into back fill. This was an easy wheeled-scraper proposition, and the price was 27 cents per cubic yard.

Seventeen thousand three hundred and nine cubic yards of concrete have been placed in the work, the heavy work being completed upon November 12, 1899, and the last piece of pavement having been laid April 7, 1900. The concrete used was of three varieties, depending upon the proportion of cement, as follows:

No. 1: 1 cement, 2 sand, 4 gravel.
No. 2: 1 cement, 3 sand, 6 gravel.
No. 3: 1 cement, 4 sand, 8 gravel.

No. 1 was used only for pavement and steps. No. 2 was used in the gun platforms. No. 3 was used in all the rest of the work.

Itemized and total cost per cubic yard is given below for No. 2 and No. 3. For No. 1 the cost is per square yard, it having been used entirely as a pavement course 3.25 inches thick.

No. 1 concrete, 5,986 square yards:	
Sand and granolithic material	$0.134
Cement	.658
Labor, mixing and placing	.344
Forms, labor and material	.141
False work and engine tower	.018
Total cost per square yard	1.295
No. 2 concrete, 2,270 cubic yards:	
Sand and gravel	1.590
Cement	2.743
Labor, mixing and placing	.677
Forms, labor and material	.754
False work and engine tower	.202
Total cost per cubic yard	5.966
No. 3 concrete, 14,362 cubic yards:	
Sand and gravel	1.590
Cement	2.059
Labor, mixing and placing	.677
Forms	.754
False work and engine tower	.202
Total cost per cubic yard	5.282

Facing, 105 cubic yards:

Sand	$1.590
Cement	3.902
Labor, mixing and placing	.677
Forms, labor and materials	.754
False work and engine tower	.202
Total cost per cubic yard	7.125

The proportions for facing are 1 cement, 6 sand, and it was used for the ceilings of all rooms and galleries.

The foundations are in hardpan and are thoroughly drained by tile pipe emptying into the main drainage system. Walls against which fill was made were first waterproofed with a solution of lye, alum, and cement, which has proved most satisfactory in similar work at the mouth of the Columbia River. Walls to be in contact with original ground were first run up 3 feet scant. This face was waterproofed as above; then the remaining 2 feet of wall was put in, but vertical columns of sand leading down to the tile pipe were spaced every 5 feet along this outer face. This battery has proved perfectly dry.

A stippled finish has been given to all pavements and is more satisfactory than a polished finish, since it does not become slippery in wet weather.

The roadway in rear of the battery is provided with concrete gutters on each side and is surfaced with material from some old brickkilns which were on the reservation.

Experience seems to indicate that the superior slope in its present shape will raise grass. Experiments are now in progress, and if they are successful the entire slope will be seeded this fall. This will allow of the omission of the blast-proof aprons. These have not been put in, pending final settlement of the fill upon which they rest.

The plant for this work is fully described, both in construction and operation, in Report of the Chief of Engineers, 1899.

Plans and estimates for electrically lighting this battery have been forwarded to the Chief of Engineers and by him approved. Allotment for this work was made, but the money was afterwards authorized to be used for other purposes; hence no work has been done.

This battery is equipped with a complete water-supply system, latrines, and hose connections.

The special ammunition trucks required for the service of this battery have yet to be constructed.

Emplacements for sixteen 12-inch mortars.—Clearing for this battery was done by day labor, and was commenced on July 6, 1899. Excavation was done by contract, was commenced August 8, 1899, and was completed April 11, 1900. The excavation was made with wheeled scrapers, and the contract price was 27 cents. Sixty-five thousand eight hundred and sixty-one cubic yards were taken out.

The first concrete was laid December 2, 1899, and heavy concrete work was completed March 17, 1900.

Ten thousand two hundred and ninety cubic yards have been placed, the classification and uses being the same as in the gun emplacements. The cost is as follows:

No. 1.—3,610 square yards, 2¼ inches thick:

Forms, labor and materials	$0.136
Sand and granolithic material	.122
Cement	.559
Labor, mixing, placing, surfacing	.365
Railroad	.019
Miscellaneous supplies	.004
Total cost per square yard	1.205

No. 2.—988 cubic yards:

Sand and gravel	1.614
Cement	2.588
Labor, mixing, and placing	.585
Forms	.777
False work	.316
Railroad	.242
Miscellaneous supplies	.049
Total cost per cubic yard	6.171

No. 3.—8,848 cubic yards:

Sand and gravel	$1.614
Cement	2.036
Labor, mixing and placing	.585
Forms, labor and materials	.777
False work	.316
Railroad	.242
Miscellaneous supplies	.049
Total cost per cubic yard	5.619

Facing (1 cement, 6 sand) 182 cubic yards:

Sand	1.614
Cement	3.884
Labor, mixing and placing	.585
Forms, labor and materials	.777
False work	.316
Railroad	.242
Miscellaneous supplies	.049
Total cost per cubic yard	7.467

The back fill, amounting to 22,926 cubic yards, was made by informal agreement at 27 cents per cubic yard.

The foundations are in hardpan, and are thoroughly drained by tile pipe emptying into the main drainage system. The roofs of galleries and rooms, where covered with earth, were given a one-half inch coat of asphalt, and vertical walls in contact with the earth are faced with hollow brick, draining into the pipe at the bottom. This battery is perfectly dry.

The pavements have been given a stippled finish, and the roadway is provided with concrete gutters and will be finished with a gravel surface if the funds permit.

There is still a small amount of pavement to be laid in this battery, but it can not be done until the arrival of the remainder of the mortar carriages. Besides this, there is needed only a small amount of whitewashing and painting to complete this battery.

The plant used upon the gun emplacement work was used for hauling material up the hill and mixing concrete. From the mixers the concrete was conveyed to the mortar battery in bottom dump cars drawn by a small Porter locomotive, and was dropped into place from three parallel overhead tracks running the entire length of the battery.

Considering both gun emplacements and the mortar battery at this site, No. 3, the following has not been distributed:

Miscellaneous houses	$5,075.89
Water supply, including abandoned well	9,183.86
Miscellaneous plant	21,108.40
Office and quarters	3,341.10
Wharf	9,395.15
Tramway complete	7,379.02
Mixer house complete	7,007.90
Incidentals	24,785.11
Total	87,276.43

Taking combined yardage of gun emplacements and mortar battery, 27,599, this amounts to $3.162 per cubic yard. This should not appear as a charge against the concrete, however, as all the machinery and most of the materials are as good as new and will be used in other works. The houses are necessary since this piece of land was almost in its original condition, and the "incidentals" is composed of such items as "watchman," "fence around work," "office expenses," "field and office work," etc., which can scarcely be charged to any particular account.

Estimates and plans were submitted September 22, 1899, for electrically lighting the mortar battery, with duplicate plant. Allotment was made, but the money was afterwards, by authority, diverted to other uses; hence all work upon this account is deferred.

Experience seems to prove the economy of the Government furnishing its own boat and scows for transporting concrete materials. Selecting the month upon each the gun emplacements and the mortar battery, when the output of the concrete was the largest, we have the following figures:

Gun emplacement, period August 1 to August 31, 1899, inclusive, 23 working days:

Sand and gravel at wharf	$5,521.00
Handling	1,254.83
Mixing and placing	2,531.78
Superintendence	325.00
Total	9,632.61

Concrete placed, 4,177.13 cubic yards.
Cost per cubic yard, $2.31.

Mortar battery, period January 30 to March 1, 1900, inclusive, 23 working days:

Sand and gravel at wharf	$4,383.30
Handling	1,319.85
Mixing and placing	2,274.85
Superintendence	325.00
Total	8,303.00

Concrete placed, 4,972.5 cubic yards.
Cost per cubic yard, $1.67.

Difference in favor of Government owning floating plant, $0.64 per cubic yard. The saving is due to two causes—cheaper towing and being able to run the mixing plant up to its capacity. This last was possible because the Government floating plant furnished a regular and adequate supply of materials. Only such items are introduced in this comparison as would have their cost affected by the circumstance under which the sand and gravel are supplied.

Emplacements for two 5-inch rapid-fire guns on balanced-pillar mounts.—Excavation was commenced April 7, 1900, and the first concrete was laid April 25, 1900. Heavy work was completed June 18, 1900. Upon June 30, 1900, only the painting and whitewashing, a small area of paving, and the sodding of the slopes remains to be done.

Concrete material was conveyed, in cars drawn by a small locomotive, from the wharf to a platform elevated above the mixing platform. Here a charge of materials was measured up and allowed to fall about ten feet, being thrown back and forth during this fall by inclined boards. The materials were thus pretty well mixed. Upon the mixing platform the charge was turned twice by shovelers, while a sufficiency of water was played on it from a hose. It was then conveyed to place in barrows. This furnished an excellent quality of concrete, and the cost per yard is as follows:

Sand and gravel	$1.246
Cement	2.239
Mixing and placing	1.044
Forms	1.034
Plant	.802
Superintendence	.225
Total	6.590

One thousand and ninety-five cubic yards were placed. All exterior walls are waterproofed with lye, alum, and cement solution, and the foundations are drained by tile pipes. The slopes are composed of fine sand, and to prevent this from drifting it has to be sodded. The cast-iron cylinders to be set in gun platforms have not yet arrived.

MOUNTING GUNS AND CARRIAGES.

Four 10-inch gun carriages and one 12-inch gun carriage have been received, removed to their emplacements, and mounted at a cost of $183.525 per 10-inch carriage and $417.31 for the 12-inch altered gun-lift carriage.

Ten 12-inch mortar carriages have been received, conveyed to their emplacements, and mounted at a cost of $232.183 per carriage. The only other ordnance received is one 10-inch rifle, two 12-inch mortar carriages, and sixteen 12-inch mortars. This material is now on the beach.

POSITION FINDERS.

Estimates were forwarded for towers at the fire commander's and all battery commanders' stations. Allotment has been made for the fire commander's tower, but no work has been done.

SITE NO. 4.

Emplacements for three 8-inch guns on disappearing carriages.—Plans for this battery have been approved, allotment made, and work was commenced March 1, 1900.

A wharf with sand and gravel bunkers upon it has been completed by contract at a cost of $4,125.77.

Clearing has been completed by contract, 5.7 acres at $185 per acre.

Excavation is in progress by contract. The contract price is 39 cents per cubic yard, and upon June 30, 1900, 12,637 cubic yards have been moved. All excavated material goes into back fill.

Five thousand barrels of cement for this work were purchased in January, 1900, and housed in a shed erected for the purpose.

Sand and gravel are to be obtained under contract, price 55 cents per cubic yard, on Government scow alongside the contractor's wharf. Towing will be done with the Government steamer.

This plant is to be similar in general features to the one installed at site No. 3, but will be much less elaborate, this being a comparatively small work. Much of the grading and trestling for the tramway and mixer house have been done.

It is estimated that the excavation will be completed July 15, 1900; that the plant will be in place and the first charge of concrete put in about August 1, 1900, and that this work will be completed by January 1, 1901.

Emplacements for two 6-inch rapid-fire guns, Navy pattern, on pedestal mounts.—Plans and estimates for this battery have been approved and allotment made for two emplacements. No work has at present been done under this allotment, but the two emplacements will be completed during the next fiscal year. Some materials have been purchased.

Emplacements for two 15-pounder rapid-fire guns on balanced-pillar mounts.—Plans and estimates for this battery have been approved and allotment made. No work has yet been done, but the battery will be completed during the next fiscal year. Some materials have already been purchased.

Emplacements for four 15-pounder rapid-fire guns on balanced-pillar mounts.—Plans and estimates for this battery have been called for and will be submitted early in the next fiscal year.

SITE NO. 5.

Emplacements for two 6-inch guns on disappearing carriages.—Plans and estimates for this battery have been submitted to the Chief of Engineers, but are held pending probable change in the mount. From the preliminary allotment of $5,000 a detailed survey of site No. 5 has been made, and $1,700 was used to purchase the old plant from the contractors at site No. 2. Nothing else has been done upon this battery.

Emplacements for two 15-pounder rapid-fire guns on balanced-pillar mounts.—Plans and estimates for this battery have been approved and allotment made, but no work has been done. Some materials have been purchased, and the work will be completed during the next fiscal year.

TORPEDO STOREHOUSE.

Plans and estimates for a concrete and brick storehouse were approved, and after advertisement the contract was let to Mr. Morgan J. Carkeek, of Seattle, Wash., at $6,829. The United States furnishes the sand, gravel, and cement, and the contractor furnishes all other materials and appliances and executes the work. Work was commenced about April 25, 1900, and upon June 30, 1900, the concrete in the foundations and walls and the stone water-table course are in place. Everything is now ready to commence laying brick, and it is hoped this work can be finished upon the contract time—August 19, 1900.

CABLE TANK.

The temporary cable tank constructed in the bed of a stream proves to be satisfactory as a permanent tank. It will be necessary to roof it over in order to keep all sorts of trash from blowing into it.

APPENDIX No. 4.

POST OF FORT TOTTEN, NEW YORK—UNITED STATES ENGINEER SCHOOL—BATTALION OF ENGINEERS—ENGINEER DEPOT.

REPORT OF MAJ. JOHN G. D. KNIGHT, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1900.

UNITED STATES ENGINEER SCHOOL,
Fort Totten, Willets Point, N. Y., July 20, 1900.

GENERAL: I have the honor to forward herewith, in duplicate, annual report on the post of Fort Totten, N. Y., the United States Engineer School, the Battalion of Engineers, and the Engineer Depot, for the fiscal year ending June 30, 1900.

Very respectfully, your obedient servant,

JOHN G. D. KNIGHT,
Major, Corps of Engineers, Commanding.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

I.—POST OF FORT TOTTEN, N. Y.

The post-office and telegraph office for this post are on the reservation and are known by the reservation name of Willets Point, N.Y.

The Bell Telephone Company has an office on the post connected with a central office at Flushing, N. Y.

The nearest railroad stations are Whitestone and Bayside, on different branches of the Long Island Railroad and about 2 miles distant.

Two mails are sent out and received daily, except Sundays, when but one, carried by post transportation to and from Whitestone.

The telegraph office is in charge of an engineer soldier, without increased compensation from either the United States or the telegraph company. He should receive extra-duty pay for his steady and confining services.

The responsibility of the post commander to the Chief of Engineers, United States Army, in all matters relating to the administration and discipline of the post was modified January 5, 1900, when the Assistant Secretary of War directed that all correspondence relating solely to artillery matters at Fort Totten be thereafter forwarded direct to the Commanding General, Department of the East.

In matters relating to instruction, drill, and practice the artillery force of the garrison is not under the control of the post commander, but is under such control so far as relates to administration and discipline.

Allotments and expenditures for repairs of buildings, etc., were as follows:

Purpose.	Date of allotment.	Allotted.	Expended.	Balance unexpended.
Barracks and quarters	Aug. 14, 1899	$2,394.60	$2,394.60	....
Do	May 26, 1900	2,460.00	1,998.18	$461.82
Roads and walks	Apr. 14, 1899	2,553.50	2,036.16	517.34
Do	May 23, 1900	895.00	632.60	262.40
Heating apparatus	Apr. 13, 1900	1,750.00	1,507.89	242.11
Plumbing	July 12, 1899	842.30	649.41	192.89
Do	May 14, 1900	493.95	380.63	113.32
Hospital	July 15, 1899	350.43	350.43	....
Hospital stewards' quarters	July 22, 1899	164.34	149.36	14.98
Total	....	11,904.12	10,099.26	1,804.86

The expenditures for repairs during the fiscal year 1899 amounted to $5,522.21.

The hospital roof was reshingled, but other repairs to post buildings and roads were of minor character.

An artillery barrack for 120 enlisted men is under construction.

New brick buildings are greatly needed for quarters for the noncommissioned post and battalion staff and for band barracks; others should be erected to replace at least four sets of officers' frame quarters constructed in 1867.

All the buildings asked for should be built, whether the headquarters of the Battalion of Engineers continues at this post or not. They will be required for the artillery garrison, larger than the existing one, called for by the artillery armament of the post.

For a single relief for this armament there should be an artillery force stationed here double the present; for two reliefs there should be about 450 men. Existing barracks and that now under construction would quarter this force and the Engineer detachment needed to care for the supplies of the Engineer Depot.

Legislation recently proposed has contemplated the transfer of submarine mining defenses to the artillery arm of the service. I believe this transfer should not be made; but should it be, there will no longer be any necessity for stationing the Battalion of Engineers on the seacoast. Should the transfer not be made, either the barracks and quarters here must be materially added to, to accommodate the larger artillery force demanded, or another seacoast station must be secured for the Battalion of Engineers and incidentally the United States Engineer School.

In either case the United States Engineer Depot should remain here or be in closer vicinity to New York City, so that in emergencies advantage could be had of New York markets.

The garrison of the post has consisted of headquarters, band, Companies B, C, and D, Battalion of Engineers, and Battery N, Seventh Artillery.

Company B, Battalion of Engineers, left for Manila July 5, 1899.

Company C returned from duty at Camp Meade, Pa., July 22, 1899.

Officers of the Corps of Engineers on duty during the year are reported later; other officers and acting assistant surgeons have been on duty as follows:

Maj. H. S. Turrill, surgeon, July 1, 1899, to April 28, 1900.
Maj. W. F. Carter, surgeon, since April 24, 1900.
Maj. John Millis, Corps of Engineers, March 29 to May 5, 1900.
Capt. W. L. Sibert, Corps of Engineers, June 10 to June 27, 1900.
Capt. G. W. Van Deusen, Seventh Artillery, July 1 to September 26, 1899, April 14 to 22, 1900, and since May 10, 1900.
First Lieut. A. Moses, Third Artillery, September 21 to December 15, 1899.
Second Lieut. H. L. Newbold, Seventh Artillery, since December 9, 1899.
A. A. Surg. H. M. Cohen, July 1 to 5, 1899.
A. A. Surg. R. A. Wilson, since July 1, 1899.

All organizations stationed here took part in the parade in honor of Admiral Dewey in New York, September 30, 1899, and the Battalion of Engineers participated in the parade in that city May 30, 1900, in observance of Memorial Day.

The census taken June 1, 1900, determined that 162 civilians were then residing on the post, 17 less than were residing here November 18, 1899.

November 16, 1899, the Major-General commanding the Department of the East visited the post, received an artillery salute, and reviewed the Battalion of Engineers. The battery of artillery was not reviewed, as it was preparing for duty at the seacoast armament.

During the month of June assistance was rendered Capt. E. M. Weaver, jr., First Artillery, U. S. A., in acquiring familiarity with the submarine-mining system.

II. UNITED STATES ENGINEER SCHOOL.

COMMANDANT.

Maj. John G. D. Knight, Corps of Engineers, United States Army.

The regulations of this school are to be found in General Orders, No. 63, Headquarters of the Army, series of 1897, and on pages 565–567, Annual Report of the Chief of Engineers, United States Army, 1898.

The period of instruction of officers is two years, beginning October 1, the first month being devoted to reconnaissance work. No reconnaissance work was done, as the companies were absent most of the month at Creedmoor, Long Island, engaged in target practice.

November 1, the time for beginning theoretical instruction, found here two instructors, and four officers of the first winter's class, November 7, one officer of the second winter's class rejoined from leave of absence. The operations of the school are reported below in the order of departments of instruction given in school regulations.

A tabulated statement follows showing officers under instruction and the parts of the course of instruction taken by them.

A.—DEPARTMENT OF MILITARY ENGINEERING.

Instructors: Capt. Thomas H. Rees, Corps of Engineers, until January 5, 1900; Maj. John Millis, Corps of Engineers, from that date until May 5, 1900.

The fourteen weeks' course of instruction began January 24, 1900, and continued until April 27, 1900.

Details of the course of instruction ordered, upon the recommendation of the academic staff, are as follows:

First week.—War ships: Classification, construction, armor, armament, speed, maneuvering power, draft, vulnerability, methods of attack on works, strength of navies of nations.

Second, third, and fourth weeks.—Seacoast guns and mortars: Kinds, construction, power, penetration, range, accuracy, mounts, rapid-fire guns.

Projectiles: Kinds and uses, effects, high explosives in shells, weights, storage, and handling.

Powder and other explosives: Kinds, uses, charges, storage, and handling.

Seacoast batteries: Types for different sites, location, design, estimates, construction, plant, stability of gun platforms, dampness in magazines, care, ammunition, service.

Fifth week.—Operations of defense: Preparation, control of batteries, range-finding, communications, relocating, service of guns, targets.

Protection against land attack.

Examples of engagements between ships and forts: Crimea, civil war, Egypt, Cuba.

Sixth, seventh, and eighth weeks.—Project for defense of designated harbor, with memoir and estimate of cost.

Field engineering: Works and trenches, object, location, design, construction, tasks and time, obstacles, construction and destruction, preparation of position for defense, attack and defense. Examples.

Demolitions.

Ninth, tenth, and eleventh weeks.—Military roads and telegraph lines, military bridges.

Reconnaissance of roads and positions, military topography, maps, manifolding.

The service of security and information.

Organization and tactics.

Twelfth week.—Transportation and care of troops. Duties of engineer officers as staff officers.

Thirteenth and fourteenth weeks.—Study of campaigns, marches, and battles, with a view to illustrating the principles of strategy, logistics, and grand tactics.

As part of the examination in military engineering, officers were required to prepare projects for the defense of certain harbors.

B.—DEPARTMENT OF ELECTRICAL ENGINEERING.

Instructor: Maj. John Millis, Corps of Engineers, until May 5, 1900.

The sixteen weeks' course of instruction began November 1, 1900, and continued until February 23, 1900.

Details of the course of instruction ordered, upon the recommendation of the academic staff, were as follows:

First week.—Arc lamps.

Second week.—Incandescent lamps.

Third and fourth weeks.—Continuous-current motors and generators.

Fifth and sixth weeks.—Alternating-current motors, transformers, and polyphase apparatus.

Seventh week.—Conductors and insulators.

Eighth and ninth weeks.—Initial-power apparatus.

Tenth week.—Telegraph, telephone, and signaling apparatus and lightning protection.

Eleventh week.—Electro-thermal and electro-chemical applications and "X" rays.

Twelfth week.—Measuring and testing apparatus and miscellaneous.

Thirteenth and fourteenth weeks.—Submarine-mining material and applications.

Fifteenth and sixteenth weeks.—Specifications, tests, and general practical applications.

The more detailed weekly programmes used during the preceding season's course were revised, rearranged in certain details, and printed for the use of officers.

After the close of the theoretical instruction in 1899, the officers of the last year's class made a number of visits of inspection to various electrical factories, central power stations, and electrical laboratories in New York and vicinity. Written reports of these visits, illustrated by photographs and sketches, were submitted.

Practical work in planting and raising mines continued during the summer with details of men from the engineer companies present under the supervision of officers who had taken the theoretical course during the previous winter. The new mining casemate was used in these drills.

Various instruments, tools, and materials for use in the electrical work have been received, and the books of reference for the use of officers have been kept well up to date by the purchase of the latest works on subjects pertaining to the course.

C.—DEPARTMENT OF CIVIL ENGINEERING.

Instructors: Capt. Thos. H. Rees, Corps of Engineers, until November 1, 1899; the commandant from November 1, 1899, until January 23, 1900; since the latter date, Capt. Henry Jervey, Corps of Engineers.

The first winter's course of nine weeks began February 27, 1900, and ended April 30, 1900.

Details of this course ordered, upon the recommendation of the academic staff, were as follows:

First week.—Preliminary surveys and examinations.
Second week.—Topographical surveying.
Third week.—Surveys of location.
Fourth week.—Hydrographic surveys.
Fifth week.—Foundations.
Sixth and seventh weeks.—Strength of materials.
Eighth and ninth weeks.—Hydraulic cement and concrete.

The second winter's course of eleven weeks began November 1, 1899, and ended January 23, 1900.

Details of this course ordered, upon the recommendation of the academic staff, were as follows:

First week.—Concrete.
Second week.—Regulation of rivers.
Third and fourth weeks.—Canalization of rivers.
Fifth week.—Canals; locks and lifts.
Sixth week.—Dredging.
Seventh week.—Improvement of harbors and estuaries on sandy coasts.
Eighth week.—Breakwaters and light-houses; location of bridges.
Ninth and tenth weeks.—Engineering plant and method of construction.
Eleventh week.—Preparation of estimates.

The season for practical instruction extends from May 1 to November 1.

During the season 1899, hydrographic surveys were conducted by Lieutenants Wolf and Ferguson, and astronomical work by Lieutenants Wolf, Cheney, and Altstaetter.

During the present season of 1900, hydrographic surveys and astronomical work have been carried on by all officers present under instruction.

The following is the ordinary routine of observations with the several astronomical instruments, after reasonable proficiency has been attained by preliminary practice:

Theodolite. Determination of azimuth.

Sextant. After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and west star—each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant, using a portable chronometer, and will determine by comparison the error of the standard chronometer at the observatory.

Chronograph. Daily determination by time signal from Washington, D. C., of error and rate of astronomical clock.

Transit. A satisfactory set of time observations will be taken by each officer on two nights, successive if possible, determining satisfactorily the error of the sidereal clock. The eye and ear method will be employed.

Zenith telescope. Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly, they will observe for latitude, until they have obtained a satisfactory determination.

Longitude by telegraph.

Lieutenant Altstaetter, having been relieved from duty at the school April 27, 1900, for service at Manila, completed only the theoretical course of instruction.

The museum of engineering models was visited in November, 1899, by a number of the freshmen class of the New York University, who were taking an engineering course.

The statement of funds appropriated and expended for school purposes, and the estimate of funds needed for the same, are to be found in following pages.

The museum building, which is also occupied as a library building, is entirely too small for the purposes for which used. Additions to both the museum and the library can no longer be properly placed or cared for. An addition to the building should be erected, and $12,000, the cost thereof, is included in estimates submitted below.

[c., completed; n. c., not completed.]

	Theoretical instruction.				Practical instruction.	Remarks.
	Electrical engineering.	Civil engineering.		Military engineering.		
	Winter's.					
	First.	First.	Second.	Second.		
First lieutenants.						
Stuart, Edwin R					n. c.	Relieved Aug. 19, 1899.
Hoffman, George M					n. c.	Relieved Aug. 1, 1899.
Oakes, John C					n. c.	Relieved July 5, 1899.
Wolf, Louis C				c.	n. c.	Absent on sick leave Sept. 1, to Nov. 7, 1899, and since June 8, 1900.
Cheney, Sherwood A					n. c.	Relieved Sept. 26, 1899.
Altstaetter, Frederick W			c.	c.	n. c.	Relieved Apr. 27, 1900.
Ferguson, Harley B					n. c.	Relieved July 5, 1899.
Smith, Clarke S	c.	c.			n. c.	Attached Aug. 13, 1899.
Second lieutenants.						
Brown, Lytle	c.	c.			n. c.	Attached Aug. 14, 1899; relieved June 24, 1900.
Brown, Earl I	c.	c.			n. c.	Attached Sept. 13, 1899.
Fries, Amos A	c.	c.			n. c.	Attached Oct. 1, 1899.

III.—BATTALION OF ENGINEERS.

No changes have been made during the year, except in personnel and stations.

It is again recommended that appropriate legislation be urged authorizing two cooks to a company of engineers, each to take rank as, and be allowed the pay of, a corporal of engineers.

But one cook is now authorized for an engineer company of 150 men, although two cooks are authorized for other organizations of the line having an enlisted strength of 120 men or less.

During the months from November to March, inclusive, the instruction of the battalion is as follows:

The noncommissioned officers receive theoretical instruction in their duties, some in photography; all men are instructed in the shore duties of submarine mining, and the companies have one drill weekly in the manual of arms.

The duties for the remaining months are:

	Companies.	
	C.	D.
Company infantry drills	April.	
Battalion infantry drills	May.	
Ponton and rope bridges and special instruction in rowing	June	August
Field and siege works, hasty cover, and defiling against infantry fire	July	June.
Submarine mines; special instruction of officers and selected noncommissioned officers in mining casemate duty, including firing of simulated triple groups on shore; swimming	August	July.
Trestle and spar bridges	September	October.
Target practice and reconnaissance; signaling for noncommissioned officers and selected privates	October	September.
Company and battalion infantry drills	November.	

It is difficult to summarize the various duties performed by Companies A and B in the Philippines. They include reconnaissance, map making, and photography; building and repairing roads, railroads, and bridges; constructing rope ferries; guarding railroads, trains, and workmen, and duty at outposts and on the firing line. The field of operations was not limited to the island of Luzon, and service was had under Generals Lawton, MacArthur, Bates, Schwan, and Wheaton.

Captain Sibert and Lieutenants Ferguson, Wooten, and Stickle have been favorably mentioned in reports that have come to my notice. In justice to other engineer officers serving with these companies it should be borne in mind that reports of their superiors do not, as a rule, reach these headquarters.

The duties of Company E, stationed at the United States Military Academy, are to assist in the instruction of cadets in practical military engineering, to guard the post of West Point, and furnish teachers for the post school.

Company A left this post May 24, 1898, for service in the Philippines.

Company B left this post July 5, 1899; San Francisco, July 13, two days after its arrival there; Honolulu, July 23, three days after its arrival there; arrived at Manila August 10 and debarked August 13.

Company C, which had left this post for Camp Meade, Pa., March 15, 1899, returned July 22, previously having in the meanwhile prepared a camp at that place to be occupied by 6,000 troops returning from Cuba.

Two noncommissioned officers and four privates were detached from Companies C and D February 13, 1900, for duty in connection with road making in Alaska.

During October, 1899, with the kind permission of Governor Roosevelt, Companies C and D each encamped for six days on the grounds of the Creedmoor target range and utilized the range for five days of target practice.

The battalion commissioned staff during the year has been:

First Lieut. Geo. P. Howell, adjutant.

First Lieut. Wm. B. Ladue, quartermaster.

The latest company returns covered by my last annual report were for the month of April, 1899; subsequent returns, to include those for April, 1900, of Company A; for May, 1900, of Company B, and for

June, 1900, of the remaining three companies, are covered by this report.

Officers of the Corps of Engineers were on duty with engineer companies as follows:

COMPANY A.

Capt. Francis R. Shunk, absent sick from December 29, 1899, relieved while absent.

First Lieut. Sherwood A. Cheney, November 3 to December 23, 1899, when relieved for other duty in the Philippines.

Second Lieut. William P. Wooten.

Second Lieut. Horton W. Stickle.

COMPANY B.

Capt. William L. Sibert, relieved September 15, 1899, to act as Chief Engineer Department of Pacific and of Eighth Army Corps.

First Lieut. John C. Oakes.

First Lieut. Harley B. Ferguson.

COMPANY C.

Capt. Thomas H. Rees, relieved January 9, 1900.

Capt. Henry Jervey, since January 22, 1900.

First Lieut. Edwin R. Stuart, relieved August 19, 1899.

First Lieut. George M. Hoffman, relieved August 14, 1899.

First Lieut. Louis C. Wolf, since February 4, 1900; absent sick since June 7, 1900.

First Lieut. Sherwood A. Cheney, August 2 to September 22, 1899.

First Lieut. Clarke S. Smith, since August 13, 1899.

Second Lieut. Earl I. Brown, since September 13, 1899.

COMPANY D.

Maj. John Millis, relieved March 28, 1900.

Capt. Francis R. Shunk, joined March 28, 1900.

First Lieut. Louis C. Wolf, absent sick September 1, 1899, to February 4, 1900, when transferred to Company C.

First Lieut. Frederick W. Altstaetter, relieved April 27, 1900, for service in Manila.

Second Lieut. Lytle Brown, August 14, 1899, to June 26, 1900, when relieved for service in Manila.

Second Lieut. Amos A. Fries, since October 4, 1899.

COMPANY E.

Maj. George W. Goethals, relieved March 13, 1900.

First Lieut. James P. Jervey, until July 29, 1899, and since June 28, 1900.

First Lieut. Harry Burgess, until June 28, 1900.

IV. ENGINEER DEPOT.

1. Public Buildings, Boats, Constructions, etc.

The property in the depot, consisting of the bridge and ponton equipage; stores for bridge and ponton trains, engineer, field, and torpedo service; astronomical, surveying, drawing, electrical instruments; photographic supplies; materials for current repairs to buildings, boats, and machinery, has been cared for.

The fireproof repair shop completed by the contractor at the close of the last fiscal year was fitted out with the necessary working machinery; for furnishing the power a 4-horsepower Hornsby-Akroyd oil engine was procured and set up; for heating the building a No. 33 Gorton steam boiler, with the required radiators, pipe and pipe fittings, water connections, etc., has been procured and installed.

The boiler room of the engineer museum was enlarged.

The extension of the engineer wharf, used almost entirely with the work in connection with torpedo experiments and the instruction of engineer troops in submarine mining, was examined with the view of having it repaired. Proposals were invited, and the work of repairing was completed November, 1899. There were driven in all 1,518 running feet of creosoted bearing piles and 788 running feet of oak fender piles, and 12,882 feet B. M. of yellow-pine timber were used to replace deck flooring and stringers.

The steamer *Bushnell* was hauled out on the beach and painted inside and out, and minor repairs were made to the machinery. The steam launch *Dyne* was painted throughout.

2. Work of the Depot.

The usual routine care of property has continued, the incidental labor having been performed by enlisted men of the Engineer Battalion, detailed on special duty during the first eleven months of the year, and by extra-duty men from June 1900.

Purchases under proposals embraced submarine mining materials, surveying instruments, drawing materials, photographic outfits, bridge and ponton equipage, intrenching and other field engineering supplies, and books and periodicals for the library of the United States Engineer School.

Twelve wooden pontons were received during the year by purchase and six more are yet to be delivered.

Materials required to complete 3 divisions of advance guard and 3 divisions of reserve train of bridge equipage were procured, except timber for long and short balks.

Five pieces cypress timber were received without cost for purpose of testing at Watertown Arsenal to determine the fitness of cypress for long balks. From the reports of the test made of these pieces it is evident that cypress lumber is entirely unsuited for use in ponton-bridge train.

Notwithstanding bids for white-pine lumber for ponton trains were invited from parties in New York, and, through the cooperation of several officers of the Corps of Engineers, in Buffalo, Duluth, and St. Paul, but one was received. The price bid was $125 per thousand, which was accepted November 25, 1899, for delivery of 150 long balks, 150 short balks, and 12 trestle balks. The time for delivery was on or before June 15, 1900. Before the time set for the delivery the bidder informed me of his inability to furnish the timber ordered. Authority having been obtained to substitute Oregon pine for clear white pine, proposals for it were invited, and the necessary quantity of it was ordered for delivery by July 15, 1900.

Unserviceable engineer property, of which a large portion was turned into the depot from the field during the past two years, was collected and inspected in December, and disposed of in accordance with the recommendation of the inspector.

Two battery and forage wagons, fitted out with necessary tools and materials, were received from the United States Ordnance Department in November for use in ponton trains.

Materials for instruction of engineer troops in their special duties were procured when needed. Among the articles bought may be mentioned the following: One cartridge kodak, with films and film holders; 1 electric storage battery of 40 chloride accumulator cells, complete; 1 boiler test pump.

3. Depot Instruments.

Surveying instruments, drawing materials, etc., have been procured under proposals opened July 29, 1900; quantity not specified, but bidders were informed that they must be prepared to supply such number as may be called for during the fiscal year ending June 30, 1900, at the prices bid.

Under the appropriation for engineer depot, "instruments," 1900, the following were purchased during the year: Six transits, engineers; 1 transit, engineers, with solar attachment; 8 levels, engineers; 10 Abbot's protractors; 28 hand levels; 15 aneroid barometers; 6 sets drawing instruments; 8 odometers; 7 triangular scales; 6 drawing pens; 4 parallel rules, 18 inches; 12 tapes, steel and metallic, 50 feet.

Repairing and overhauling of instruments on hand in the depot was continued in the depot repair shop as required for issue, and was performed by enlisted men of the engineer battalion. In the following cases time did not admit to make repairs in the depot; they were sent to instrument makers in New York City and Brooklyn, N. Y., for repairs, viz:

1 transit	$23.50	
1 proportional dividers	.75	
2 prismatic compasses	3.75	
		$28.00

The following instruments were repaired at St. Paul, Minn., under authority given the engineer officer, Department of Dakota:

1 transit, 4 surveyor's chains, and 1 steel tape	9.50
Total expended for outside repairs to instruments during fiscal year	37.50

Issues to officers of the Corps of Engineers engaged on public works, and to acting engineer officers at the different department headquarters, engaged on surveys and reconnaissance work, upon requisitions duly authorized by the Chief of Engineers, United States Army, were as follows:

8 engineer's transits.
8 binocular field glasses.
5 Abbot's protractors.
1 odometer.
16 cavalry sketching cases.
6 German silver drawing pens.
1 current meter.
1 set drawing instruments.
9 engineer's levels.
5 prismatic compasses.
5 parallel rules.
5 hand levels.
2 level rods.
2 steel tapes.
7 triangular scales.
4 magneto machines, and also 16 rolls (each 500 feet) of paper for use of tide gauges, and various drawing materials.

Various instruments and reconnaissance materials were issued for temporary use of details of the engineer battalion engaged in reconnaissance work and hydrographic surveys for instruction purposes. On completion of this duty all articles were returned to the depot.

The following instruments were received from officers of the Corps of Engineers on public works and surveys, and from acting engineer officers, viz, 2 engineer's transits, unserviceable; 5 watches, unserviceable; 2 chronometers; 1 prismatic compass, and 1 hand level.

In October, 1899, a large lot of instruments and drawing material was received from the engineer officer of the late Department of the Gulf. This property was originally invoiced to the engineer officer of the Department of the East, but there being no storage facilities at that department was received here. Among the articles received are the following, viz, 2 transits, 31 assorted triangles, 14 T-squares, 15 Abbot's protractors, 18 sketching cases, 47 assorted compasses, 27 odometers, 2 surveyor's levels, 15 assorted scales, and a number of other smaller instruments, drawing paper, and drawing materials.

Unserviceable and worthless instruments, accumulated in the depot during the past two years, received from officers in charge of public works and surveys and from engineer officers serving in the field, were made a subject of an inspection with a view to their condemnation, and the following were condemned and sold or destroyed:

4 sextants.
5 aneroid barometers.
12 mercurial barometers.
2 thermometers.
5 surveyor's compasses.
9 engineer's levels.
6 level rods.
16 metallic and steel tapes.
7 theodolites.
7 engineer's transits.
1 secondary base apparatus.
4 micrometers.
22 odometers.
27 prismatic compasses.
5 hand levels.
7 watches.
4 passometers.
3 Abbot's protractors.
10 sets drawing instruments.
8 cavalry sketching cases, and a number of miscellaneous drawing instruments and photographic supplies.

Purchases, issues, and receipts of instruments, drawing materials, etc., required for equipment of engineer troops for use in the field and to chief engineers with army corps, etc., are referred to hereafter under the heading, "Equipment of Engineer Troops."

4. INSTRUMENTS, PHOTOGRAPHIC SUPPLIES, ETC., FOR ALASKA.

Under the several orders received from the Chief of Engineers, United States Army, shipments of instruments, drawing materials, and photographic supplies were made as soon as articles called for could be purchased, if not in the depot, and packed for shipment. The following table shows the dates, articles, and names of officers to whom shipments were made during the fiscal year, viz:

Date.	Name of officers and address.	Articles sent.
1900.		
Mar. 21	Capt. W. R. Abercrombie, Port Valdez, Alaska.	1 steel tape, 100 feet. 2 sight vanes for prismatic compasses.
May 10	First Lieut. H. R. Hickok, engineer officer, Department of Alaska, at Seattle, Wash.	1 engineer's transit.
May 12	.....do.....................	4 brushes, camel's hair. 50 sheets cardboard paper. 1 roll drawing paper, 42 inches. 25 sheets drawing paper, mounted. 30 rolls blue-print paper, 30 inches. 100 sheets topographical paper. 1 roll cross section paper. 1 roll profile paper. 6 rolls black-process paper, 30 inches. 1 German silver pen. 6 dozen pencils. 1 parallel rule, German silver. 300 thumb tacks. 6 paper weights. 36 dozen dry plates, 5 by 7 inches. 3 ounces hydrochinon. 100 pounds hyposulphate soda. 4 gross aristo platino paper, 5 by 7 inches. 6 bottles chloride-platino of potassium. 6 pounds platino developing salts. 2 gross tubes hydrometol developer.

Date.	Name of officers and address.	Articles sent.
1900. May 12	First Lieut. H. R. Hickok, engineer officer, Department of Alaska, at Seattle, Wash.	1 ounce uranium nitrate.
		5 pounds chrome alum.
		2 ground glasses, 10 by 12 inches.
		2 pounds hydrochloric acid.
		24 boxes platinotype paper, 5 by 7 inches.
		500 envelopes, photo.
		12 dozen dry plates, 5 by 7 inches, achromatic.
		1 graduated glass, 16 ounce.
		1 ruby glass, 10 by 12 inches.
		1 orange glass, 10 by 12 inches.
		1 gross sheets velox paper, 10 by 12 inches.
		1 stand for camera.
		1 pound acetate soda.
		1 pound bichloride mercury.
		6 bottles chloride of gold.
		2 pounds bromide potassium.
		2 pounds phosphoric acid.
		144 packages developing powders.
		6 glass bottles with stoppers.
		4 printing frames, 5 by 7 inches.
		12 jars photo mounting paste.
		1 print trimmer, 11 inches.
		1 roller for mounting, 12 inches.
		4 gross envelopes, negative.
		1 lantern, dark room.
		12 bottles aristo gold solution.
		12 bottles aristo platino solution.
		3 printing frames, 8 by 10 inches.
		2 rubber trays, 10 by 12 inches.
		3 ounces metol.
		5 pounds sulphite soda.
		5 pounds carbonate soda.
		8 pounds bicarbonate soda.
		6 gross sheet velox paper, carbon, 5 by 7 inches.
		4 pounds borax.
		1 King camera, 8 by 10 inches, with Zeiss lens and Bausch & Lomb shutter.
		5 plate holders for the above.
		1 tripod for the above camera.
		1 leather case for the above camera.
		2 rolls velox paper, 20 inches wide.
		81 yards white oilcloth.
June 16	.....do.....................	10 dozen dry plates, 8 by 10 inches.
		5 gross sheets velox paper, carbon, 8 by 10 inches.
		10 rolls films for Eastman's No. 4 kodak.
		1 dozen ferrotype plates, 10 by 14 inches.
		1 negative rack.
		1 ray screen.
		1 set scales, pocket, with weights.
		1 pound alum, powdered.
		1 pound acetic soda.
		1 dozen kits, 5 by 7 inches–8 by 10 inches opening.
		1 set aristo spotting colors.
		8 brushes, camel's hair, 2 inches.
		8 brushes, artists.

5. SUBMARINE-MINING MATERIALS.

July 1, 1899, the Chief of Engineers United States Army furnished all officers of the Corps of Engineers, in charge of submarine-mining materials, with mimeograph lists of submarine-mining materials, with request to submit a detailed statement as to the quantities of material required, on hand, etc., at the various harbors.

Twenty-nine of these lists, covering all the localities where submarine-mining materials are stored, have been received at this office during the year from the Chief of Engineers. They were revised and returned.

These lists, upon being approved by the Chief of Engineers, were returned here for file, with instructions to issue the materials called for so far as available materials will permit.

These lists on being received here were consolidated in a book specially prepared for this purpose, in order to determine the quantities called for by all the lists, to make the proper distribution of materials, to purchase additional materials with available allotments from the appropriation for torpedoes for harbor defense, and note the materials which officers recommended to be purchased in their local markets.

The work of consolidating these lists was not completed until March, 1900, and when completed the work of preparing materials for shipment, as directed by the Chief of Engineers United States Army, was commenced, and shipments were begun as follows:

	Pounds.
April 19, 1900, to Fort Monroe, Va	50,709
May 16, 1900, to Puget Sound, Wash	61,698
May 26, 1900, to Fort Stevens, Oreg	29,298
June 13, 1900, to San Francisco, Cal	135,064
June 27, 1900, to Ballast Point, Cal	14,378
June 30, 1900, to Galveston, Tex	37,630

The Galveston lot was ready for shipment on June 30, 1900, but not having been shipped on that day is not included in the detailed statement following.

Various shipments of oil engines and rotary transformers, direct from the works of the manufacturers, were made during April and May, 1900.

The following statement gives the total issues made of submarine mining materials during the year:

Name of article.	Quantity.	Name of article.	Quantity.
Switchboards, complete........number..	5	Paraffine........pounds..	352
Operating boxes, new........do....	59	Rosin........do....	72
Mine number disks........do....	434	Beeswax........do....	72
Cable tags........	399	Marine glue........do....	35
Rotary transformers........number..	5	Wood alcohol........gallons..	36
Oil engines, 4-horse power........do....	6	Asphaltum varnish........do....	7
Signal batteries........	40	French varnish........do....	1½
Extra zincs for the above........number..	40	Vermilion........pounds..	3
Testing sets, portable........do....	6	Shellac........do....	8½
Galvanometers, Bradley's........do....	6	Sulphuric acid, c. p........gallons..	9½
Reading microscopes........do....	6	Hydrochloric acid, c. p........do....	9
Reversing keys........do....	1	Sulphate of copper........pounds..	120
Circuit detectors........do....	31	Sal ammoniac........do....	91
Testing batteries........do....	6	Fusible soldering alloy........do....	21
Bell batteries........do....	3	Common solder........do....	104½
Leading wire, No. 16........feet..	27,000	Domes for ground mines........number..	2
Cotton braided wire, No. 18........do....	2,200	Domes for ground mine buoys........do....	1
Insulating cleats........number..	312	Clamping screws for mines........do....	13
Large staples........pounds..	75½	Compound plugs for buoyant mines, new pattern........number..	557
Small staples........do....	11	Extension pieces for buoyant mines, assorted........number..	884
Binding posts........number..	12	Circuit closers, new........	1,297
Double connectors........do....	187	Circuit regulator plugs, new...number..	1,277
Telephones, casemate........do....	26	Cut-outs, unprimed........do....	2,578
Lightning arresters........do....	20	Fuses, primed........do....	4,064
Torpedo Manuals 1898........copies..	85	Loading wire, No. 12........feet..	12,690
Notes on electricity........do....	9	Rubber packings........number..	11,310
Test books, daily........number..	60	Brass washers, new........do....	12,050
Note books, 5 by 8 inches........do....	238	Brass jointers........pounds..	17½
Pencils........do....	264	Rubber tape........do....	304
Tool boxes A, complete, with tools, etc. ....number..	6	Rubber tubing........feet..	2,810
Alcohol lamps........do....	7	Twine, flax........pounds..	184
Two ring stands........do....	7	Rubber cement........do....	107
Blow pipes........do....	8	White lead........do....	225
Balances and weights........do....	6	Red lead........do....	80
Amalgamating dishes........do....	5	Mutton tallow........do....	225
Wire brushes........do....	18	Cotton waste........do....	1,158
Mercury spoons........do....	6	Emery paper, coarse........sheets..	120
Battery syringes........do....	12	Lubricating oil........gallons..	10
Acid mixing pots........do....	12	Lead washers, assorted........number..	1,091
Glass rods........do....	13	Mooring rope........feet..	21,000
Melting dishes........do....	6	Mooring sockets........number..	3,004
Evaporators, porcelain........do....	18	Lead........pounds..	4,990
Funnels, glass........do....	26	Antimony........do....	520
Glass graduates, 8 ounces........do....	14	Tool boxes B, complete with all tools, number........	11
Emery paper, fine........sheets..	22	Socket wrenches........number..	30
Chamois skins........number..	8		
Commercial mercury........pounds..	121		

Name of article.	Quantity.	Name of article.	Quantity.
Levers for the above	64	Compound heaters ... number..	54
Plates of loading connections ... sets..	48	Grappling irons ... do....	13
Blocks, double, 6-inch ... number..	18	Field glasses, binocular ... do....	33
Blocks, single, 6-inch ... do....	19	Signal flags and staffs ... do....	36
Rope, 2-inch, for the above ... feet..	1,400	Sounding lines, 100-foot ... do....	14
Riggers' screws ... number..	18	Braided cotton line, ¼ inch diameter, feet	20,900
Vises, bench, large ... do....	5	Rope, manila, 2-inch ... coils..	10
Crowbars ... do....	15	Insulating compound, ozite ... gallons..	675
Mallets, heavy ... do....	5	Megaphones ... number..	61
Brushes for red lead ... do....	86	Telephones, boat service ... do....	26
Brushes, dusting ... do....	40	The following tools for completing tool boxes on hand:	
Anvils, 50 pounds each ... do....	21	Camel's-hair pencils ... number..	6
Plumbers' furnaces ... do....	14	Combination wrenches ... do....	2
Navy knives ... do....	282	Pliers, small ... do....	4
Melting pots ... do....	65	Nippers, small ... do....	1
Ladles ... do....	87	6-inch tool handles, with tools. do....	2
Trucks for handling mines ... do....	18	Soldering coppers ... do....	3
Cable drum frames ... do....	24	Glue pots ... do....	1
Axles for the above ... do....	24	Rules, 1-foot ... do....	2
Brakes for the above ... do....	24	Screw-drivers ... do....	6
Wash basins ... do....	20	Oilstones ... do....	1
Iron buckets ... do....	20	Shears ... do....	1
Cups, drinking ... do....	20	Hand vises ... do....	1
Coal oil soap ... pounds..	100	Files, assorted ... do....	42
Sister hooks ... pairs..	6	Brushes, dust ... do....	1
Mine shackles ... number..	786	Brushes, button ... do....	10
Anchor shackles ... do....	1,789	Cold chisels ... do....	10
Split pins for shackles ... do....	2,480	Cutting pliers, large ... do....	30
Turk's head collars, large ... do....	773	Hammers, smith's ... do....	3
Turk's head collars, small ... do....	4,828	Hammers, ball peen ... do....	16
Junction boxes, single, large ... do....	443	Hatchets ... do....	5
Junction boxes, single, small ... do...	348	Wrenches, Stillson's, 18-inch ... do....	11
Junction boxes, grand ... do...	68	Marking crayons ... do....	11
Junction boxes, triple ... do....	468	Oilers ... do....	8
Jointing boxes, single ... do....	906	Pincers, large ... do....	14
Jointing boxes, multiple ... do....	511	Round-nose pliers ... do....	8
Gaskets for the above ... do....	1,417	Hand vises, large ... do....	5
Cut-out boxes ... do....	468	Scissors ... do....	41
Gaskets for the above ... do....	468	Cotton duck ... pieces..	30
Cut-out plugs ... do....	468	S-wrenches ... number..	8
Lowering rope, 3 inches circumference, feet	36,500	T-wrenches ... do....	27
Marline ... pounds..	1,289	Measuring lines, 100-foot ... do....	6
Boat anchors, 500 pounds each. number..	14	Wrenches, monkey ... do....	9
Boat earth plates ... do....	83	Marline spikes ... do....	4
Tool boxes, C, complete with all tools, number	3	Earth plates ... do....	34
Tool boxes, D, complete with all tools, number	15	Round drive punches ... do....	34

The lists of submarine mining materials submitted by local officers show four distinct classes, viz:

1. Number called for by outline project;
2. Number on hand;
3. Number to be supplied from depot, and
4. Number to be purchased in local market.

As to class 3, the five shipments so far made very nearly complete the supplies to go from the depot; the articles still to be supplied will be shipped as soon as purchased.

As to class 4, the six lists filled thus far include nearly all of the articles recommended by the local officers "to be bought in local market," there being an ample supply of these in the depot, and it is thought that supplies in depot will very nearly fully equip all distant localities without the necessity of purchases being made in the markets of those localities.

Specifications have been prepared and proposals invited, some under public notice and others under advertisements, for the following articles ordered under the allotment of $34,000 assigned to me May 23, 1899, viz:

1,050 aluminum cases for new style circuit closer.
66,000 feet leading wire, No. 16, kerite insulated.
26,400 feet loading wire, No. 12, kerite insulated, 7-stranded.
12,000 cut-outs, unprimed.
50,000 brass washers, new.
12,000 fuzes, primed.
5,000 pounds pig lead.
293 compound plugs for mine cases and ground-mine buoys.
644 extra iron glands for compound plugs.
254 brass glands for compound plugs.
6 oil engines, 4 horsepower.
10 pounds vermilion paint.
5 rotary transformers.
22,000 rubber packings.
6 new pattern switch boards.
400 cut-cut boxes.
800 junction boxes, single, large.
110 junction boxes, grand.
1,600 extra corner bolts, with nuts, for the above.
2,400 extra clamp bolts for above junction boxes.
20 megaphones.
12 flag poles.
1,700 mine shackles.
7,500 split pins for shackles.
3,500 mooring sockets.
700 boxes rubber cement.
11,000 feet rubber tubing.
900 multiple jointing boxes.
429 T-wrenches.
200 500-pound anchors.
450 cut-out plugs.
275 junction boxes, single, small.
375 junction boxes, triple.
24 axles for cable drum frames.
2,600 anchor shackles.
1,100 split keys for mine cases.
45 binocular field glasses.
250 pairs of insulating cleats.
200 pounds connectors (brass jointers).
1,500 single jointing boxes.
4,000 extra binding screws for jointing boxes, and a number of other smaller articles; also the necessary boards and nails for making packing boxes and crates for shipping materials.

A statement of submarine-mining materials still to be provided for and detailed estimated cost thereof is now under preparation.

The consolidated list of materials for all the harbors shows an excess of mine cases and anchors at several localities, and upon recommendation from this office transfers of sundry mine cases were effected to eight localities, and corresponding purchases rendered unnecessary. It is proposed to recommend further transfers of mine cases, and to supply by transfer three hundred and seventy-six 1,000-pound and seventy-five 2,000-pound anchors.

Aluminum tubing bought in 1898, for use in making extension pieces for buoyant mine cases, 39 inches and up, was cut into required lengths, and threaded in the torpedo repair shop. The following were completed:

103 extension pieces for 39-inch and 40-inch buoyant mines.
718 extension pieces for 43-inch and 46-inch buoyant mines.
63 extension pieces for 48-inch buoyant mines.

The work connected with the receiving, packing, and shipping of submarine-mining materials was performed by enlisted men of the Engineer Battalion.

In compliance with General Orders, No. 1, Headquarters Corps of Engineers, United States Army, Washington, D. C., February 14, 1898, officers of the Corps of Engineers, in charge of submarine mining materials at the various fortifications, rendered reports of their semiannual inspections of submarine mining materials to the Chief of Engineers, United States Army. All of these reports have been referred to this office for recommendations and remark. These reports on being reviewed and recorded were returned to the Chief of Engineers, United States Army. During the fiscal year, 61 of such reports were received and acted on as above.

6. Equipment of Engineer Troops.

Instruments, drawing materials, photographic supplies, intrenching tools, materials for ponton and bridge trains, etc., procured under the fiscal-year appropriations for "Equipment of Engineer Troops," have, since the recent Spanish-American War, been briefly termed "Materials for Equipment of Engineer Troops." All materials shipped and issued to the new foreign possessions during the fiscal year, when purchase had to be resorted to, were bought from the appropriation for "Equipment of Engineer Troops," 1900.

Allotments from the above appropriation were assigned to me at various dates, beginning with the allotment of $500 on August 1, 1899, and subsequent allotments, the last on June 25, 1900. The total sum thus allotted during the year was $10,850, of which but $29.40 remains available at the end of the fiscal year.

The principal articles purchased during the year from the above allotments were articles covered by the various requisitions received from engineer officers serving with troops in Cuba, Porto Rico, and the Philippines, and referred to this office by the Chief of Engineers, United States Army, with authority to make shipments. One thousand eight hundred and eighty-eight dollars and sixty-nine cents of the above sum was expended and pledged for completing three divisions of advance-guard and three divisions of reserve-train equipage.

The articles thus purchased were as follows:

1 set of horseshoers' tools.
21½ coils assorted manila rope.
4 dozen collapsible canvas buckets.
36 oak pickets.
5 dozen heavy mallets.
4 dozen grocers' scoops.
6 dozen assorted ship augers and 18,138 feet, B. M., clear Oregon pine lumber for short, long, and trestle balks.
3 ponton chests.
3 dozen scoop shovels.
144 chalk lines.
16 canvas covers for pontons.
26 gross chalk, white and red.
96 4-lb. cans axle grease.

All the above articles were delivered during the year, except the Oregon pine, as to which reference is made under item 2, "Work of the Depot."

The purchases of materials made for issue to engineer troops serving in the field consisted chiefly of surveying instruments, reconnaissance and drawing materials, blue-print papers and accessories, and photographic outfits. Instruments, drawing materials, and blue-print papers were obtained under standing proposals holding for the whole fiscal year; photographic outfits were obtained under circular notices of from two to ten days, according to the time available for making the shipments.

All materials shipped, subject to atmospheric influences, were specially prepared for the climate for which they were destined. Blue-print papers were put up in tin foil and, as a rule, 50 rolls put in a tin-lined case; photographic materials were put up in sealed tin cases, and chemicals in sealed bottles.

During the year 19 different requisitions were made by engineer officers serving in the field.

	Requisitions.
Eighth Cavalry, United States Army, at Cuba	1
Engineer officer, department of Habana and Pinar Del Rio	3
Engineer officer, department of Matanzas and Santa Clara	7
Engineer officer, department of the Pacific	6
Engineer officer, department of Santiago	1
Engineer officer, Forty-third Infantry	1
Total	19

On July 5, 1899, various surveying instruments, drawing materials, field photographic outfits, and a supply of miscellaneous intrenching tools, carpenters' and blacksmiths' tools, etc., were turned over to Company B, Battalion of Engineers, on the day of their departure from this post for the Philippines.

On September 23, 1899, in accordance with instructions from the Chief of Engineers, United States Army, all materials necessary for two divisions of advance-guard train were prepared for shipment to the chief engineer, department of the Pacific, at Manila, P. I., and turned over to the depot quartermaster, New York City, for transfer to transport *Afrida*. Besides two divisions of materials, as called for by the ponton manual, two extra ponton wagons and a few minor extra articles were sent. Four hundred rolls of heavy blue-print paper were sent at same time.

The nine Berthon folding ponton boats, imported from England in 1898 for use in the campaign in Cuba and received back in the engineer depot in 1899, were fitted out and shipped to the commanding officer, Company A, Battalion of Engineers, at Manila, P. I., in September, 1899.

The following tables, divided into the different classes of materials, give shipments during the year from the engineer depot to engineer troops serving in the field:

I. *Issues of surveying instruments and reconnaissance and drawing materials.*

Barometers, aneroid ... number..	27
Blue-print cloth ... rolls..	50
Books:	
Level ... number..	95
Field ... do....	25
Transit ... do....	25
Note ... do....	72
Brushes, for water colors..do....	48
Board, drawing ... do....	1
Clinometers ... do....	6
Compasses:	
Pocket ... do....	113
Prismatic ... do....	29
Curves, hard rubber ... do....	3
Crayons, wax, assorted ... do....	240
Chains, surveyors', 100 ft..do....	10
Marking pins, for the above . sets..	4
Drawing instruments ... do....	13
Dividers, proportional . . number..	3
Erasers:	
Steel ... do....	12
Rubber ... do....	120
Field glasses, binocular ... do....	31
Hand levels ... do....	28
Ink:	
Black, drawing ... bottles..	32
Red, drawing ... do....	12
Assorted, drawing ... do....	37
Black, for mimeograph, pounds ...	2
Levels, engineers', complete, number ...	6
Level rods:	
Flexible ... number..	1
N. Y ... do....	14
Mimeograph ... do....	1
Odometers ... do....	81

Paper:	
Blue-print, 36-inch ... rolls..	735
Blue-print, 42-inch ... do....	563
Blue-print, 42-inch, unprepared ... rolls..	24
Blue-print, 36-inch, unprepared ... rolls..	20
Drawing, 36-inch ... do....	3½
Drawing, 19 by 24 inches, sheets ...	30
Drawing, 36-inch, mounted, rolls ...	20
Drawing, 42-inch, mounted, rolls ...	10
Manila drawing ... rolls..	1
Tide-gauge, 13-inch, 500-foot rolls ... rolls..	11
For mimeograph ... reams..	2
Cross-section ... quires..	6
Profile ... do....	6
Protractors:	
Abbot's ... number..	168
Paper ... do....	10
Pencils, assorted ... dozen..	86
Pens:	
Curve, German silver, number ...	1
Crow quill ... number..	12
Drawing, steel ... do....	27
Plane tables, with rollers..do....	2
Rulers, rubber ... do....	2
Range finders, Pratt's ... do....	1
Sketching cases:	
Batson ... do....	23
Cavalry ... do....	109
Scales, triangular ... do....	82
Straightedges, steel ... do....	1

I. *Issues of surveying instruments and reconnaissance and drawing materials*—Cont'd.

Tracing cloth:	
36 inches ... rolls..	32
42 inches ... do....	21
Tapes, metallic, 100 feet. number..	28
T-squares, 36 inches ... do....	1
Transits, engineers', complete, number ...	7
Triangles, rubber ... number..	54
Thumb tacks ... do....	512
Tubes, preserving ... do....	3

II. *Issues of field photographic outfits.*

Acid:	
Hydrochloric ... pounds..	1
Sulphuric ... do....	2
Alcohol ... quarts..	1
Ammonia ... pounds..	1
Alum ... do....	3
Borax, powdered ... do....	1
Bromide potassium ... do....	4⅛
Chloride-ammonium ... do....	4
Cotton, absorbent ... do....	2
Cyanide of potassium ... do....	1
Cameras, Premo Sr., 5 by 7 inches, number ...	1
Leather case for the above. number ...	1
Tripod for the above. number ...	1
Dry plates:	
4 by 5 inches ... doz..	6
5 by 7 inches ... do....	44
6½ by 8½ inches ... do....	20
8 by 10 inches ... do....	32
17 by 20 inches ... do....	6
Eikonogen ... pounds..	3
Films:	
Eastman's, 3½ by 3½ inches, rolls ...	12
Eastman's, 5 by 7 inches, rolls ...	48
Carbutt's, 18 by 22 inches, number ...	100
Fixing boxes, hard rubber. number ...	1
Frames:	
Printing, 5 by 7 inches. number ...	2
Printing, 8 by 10 inches. number ...	3
Blue print, 20 by 24 inches, number ...	1
Blue print, 24 by 24 inches, number ...	2
Blue print, 30 by 42 inches, number ...	1
Blue print, 36 by 42 inches, number ...	1
Funnels, glass ... number..	1
Funnel stand ... do....	1
Glasses, graduated:	
4-ounce ... do....	2
8-ounce ... do....	1
16-ounce ... do....	1
32-ounce ... do....	1

Glycerine ... pounds..	2
Gold, chloride, in 15-grain bottles, bottles ...	70
Hydrochinon ... ounces..	51
Iodine ... do....	1
Kodaks, No. 5, Eastman's, 5 by 7 inches, with Zeiss lens. number.	2
Cartridge-roll holders for the above, number ...	2
Extra finders for the above, number ...	2
Carrying cases for the above, number ...	2
Lanterns, ruby, dark-room. number ...	2
Mercury, bichloride of, pounds..	2¼
Metol ... do....	4
Nitrate of silver ... do....	1
Paper:	
Vinco, 18 by 22 inches. gross.	4½
Velox, 8 by 10 inches... do..	5
Aristo, 5 by 7 inches.. do...	5
Aristo, 6½ by 8½ inches. do....	5
Aristo, 8 by 10 inches. do....	5
Aristo, 16 by 20 inches. do....	1
Solio, 5 by 7 inches... do....	4
Aristo, 20 by 24 inches. do....	1
Solio, 8 by 10 inches.. do....	2
Litmus ... sheets..	2
Vandyke-black process, rolls ...	25
Plate holders, 5 by 7 inches. number ...	6
Potassium:	
Ferro-cyanide ... pounds..	1
Carbonate ... do....	3
Paste, photo ... jars..	12
Print mounters ... number..	1
Print trimmers ... do....	1
Scales, complete with weights, sets ...	1
Solution:	
Aristo gold ... bottles..	10
Aristo platino ... do....	58
Soda:	
Hypo ... pounds..	225
Carbonate ... do....	12
Solio hardener ... quarts..	5
Sulphate of soda ... pounds..	20
Trays:	
Hard rubber, assorted, number ...	12
Zinc ... number..	1

III. *Issues of ponton and bridge materials, intrenching tools, implements, etc.*

LIST A.—PONTON AND BRIDGE MATERIALS.

Abutment sills	number	4
Anchors	do.	16
Axle grease	pounds	128
Balks:		
Short	number	140
Trestle	do.	28
Blacksmiths' tools, 1 set in each forge wagon	sets	2
Boats, ponton, canvas, complete, number		16
Boat hooks	number	32
Cables, each 200 feet	do.	16
Canvas, cotton	yards	194
Chess, 11 feet long	number	456
Lashings	do.	524
Mallets, heavy	do.	35
Paddles	do.	80
Pickets	do.	16
Pails, rubber	do.	16
Ponton manuals	copies	10
Rack sticks	number	128
Rope, manila:		
3 in. circumference	feet	8,000
2½ in. circumference	do.	1,000
1 in. circumference	do.	6,000
Shovels, scoop	number	16
Scoops, small	do.	32
Trestles, complete	sets	4
Wagons—		
Chess	number	26
Tool	do.	2
Battery and forge	do.	2
Extra boxes for canvas covers, number		4
Extra canvas covers for pontons, number		8
Extra trestle chains	number	8

LIST B.—INTRENCHING TOOLS, IMPLEMENTS, ETC.

Axes:		
Broad	number	11
Chopping	do.	88
Adzes	do.	20
Anvils, 75 pounds	do.	1
Augers	do.	68
Auger handles	do.	35
Bill hooks	do.	6
Blocks:		
Single, iron	do.	2
Double, iron	do.	2
Snatch, wood	do.	5
Double, wood	do.	6
Single, wood	do.	6
Beeswax	pounds	6½
Bits, brace	sets	3
Bench screws	number	3
Come alongs	do.	6
Climbing irons	pairs	3
Climbing-iron straps	number	6
Cutters, pipe	do.	4
Chalk	pounds	24
Compound heaters	number	1
Cant hooks	do.	2
Cots, folding	do.	1
Clamps, carpenters'	do.	3
Chalk lines	do.	30
Chisels:		
Framing	do.	21
Firmer	do.	36
Crowbars	do.	4
Diggers, post-hole	do.	2
Forges, portable	do.	1
Files:		
Flat	dozen	2
Saw	do.	9
File handles	number	12
Grindstones	do.	3
Hammers:		
Spiking	do.	3
Hand	do.	1
Stone	do.	3
Assorted	do.	8
Horseshoers' outfits	sets	3
Hatchets, with handles	number	140
Handles, assorted	do.	182
Irons:		
Calking	do.	6
In bars, assorted	pounds	60
Knives, gabion	number	250
Ladle, steel	do.	1
Lanterns, assorted	do.	32
Lantern wicks	do.	204
Lantern globes, extra	do.	12
Levels, carpenters'	do.	10
Machetes	do.	1,024
Marline spikes	do.	4
Mallets, caulking	do.	2
Mauls, wooden	do.	4
Marline	pounds	50
Needles, sailmakers'	number	72
Nails, assorted	pounds	200
Oilstones	number	3
Oilers, iron	do.	3
Pliers, assorted	do.	6
Pencils, carpenters'	do.	6
Palms, sailmakers'	do.	18
Planes, jack	do.	3
Padlocks	do.	34
Picks	do.	30
Rules, 2-foot	do.	20
Sheaths for machetes	do.	1,024
Sledges	do.	3
Soldering coppers	do.	5
Solder, common	pounds	50
Soldering outfits	sets	2
Stocks and dies	do.	5
Saws, assorted	number	70
Shovels:		
Long-handle	do.	6
Short-handle	do.	80
Squares, steel	do.	3
Saw-sets	do.	6
Spades	do.	8
Spikes, assorted	pounds	50
Screws, assorted	gross	6

III. *Issues of ponton and bridge materials, intrenching tools, implements, etc.*—Cont'd.

LIST B.—INTRENCHING TOOLS, IMPLEMENTS, ETC.—continued.

Tool chests, carpenters', with tools	number..	3	Vises, telegraph	number..	6
Trowels, masons'	do....	6	Wire cutters	do....	3
Tape, ribbon	rolls..	10	Wrenches:		
Twine, sail	balls..	36	Stillson	do....	4
Tools, blacksmiths'	sets..	1	Monkey	do....	8
Tables, folding	number..	2	Wire, No. 12, galvanized iron	pounds..	200

In addition to the work of purchasing, packing, and shipping materials for equipment of engineer troops, considerable labor attended the storing and caring for the large lots of various materials received here from the field during the past fiscal year.

In addition to the instruments and other supplies issued to Company C, Battalion of Engineers, for use at Camp Meade, Pa., and returned to the engineer depot in July, 1899, only one lot of miscellaneous tools, implements, and materials was received in the depot during the year from the field, sent to this depot by Maj. George S. Cartwright, quartermaster, United States Army, at Matanzas, Cuba. The articles received appear to be a portion of the articles supplied from the engineer depot in 1898 to the volunteer engineer regiments, and, as a rule, in a serviceable condition.

7. HYGROMETERS AND THERMOMETERS FOR ARTILLERY POSTS.

Under date of April 18, 1900, I was informed that the Secretary of War decided that the Engineer Department shall furnish hygrometers and thermometers to artillery posts, and that the Chief of Engineers, United States Army, proposes to issue these instruments from the engineer depot; and the sum of $1,000 having been assigned to me April 24, 1900, to be applied to the purchase of these instruments, proposals were invited and opened on April 30, 1900, and the following were ordered and all delivered by June 20:

100 hygrometers and 500 thermometers.

Twelve requisitions were received for these articles and filled.

The number issued to various artillery posts to June 30, 1900, was 34 hygrometers and 150 thermometers.

Statement of funds.

I. ENGINEER DEPOT AT WILLETS POINT, N. Y.

Fiscal year 1899.

July 1, 1899, balance unexpended		$19,367.03
July 29, 1899, turned into the Treasury	$287.61	
August 3, 1899, withdrawn	12,000.00	
October 17, 1899, turned into the Treasury	1,652.39	
June 30, 1900, amount expended during fiscal year	4,077.03	
		18,017.03
July 1, 1900, balance unexpended		1,350.00
July 1, 1900, outstanding liabilities, for 6 wooden ponton boats complete..		1,350.00

II. ENGINEER DEPOT AT WILLETS POINT, N. Y.

Congress appropriated for the fiscal year ending June 30, 1900—

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For purchase of materials for use of United States Engineer School and instruction of engineer troops (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For library of the United States Engineer School, for purchase and binding of professional works of recent date treating of military and civil engineering (library)	500.00
Total	10,000.00

Of this there has been expended and pledged—

	Expended.	Pledged.	Total.
1. For incidental expenses of depot (incidentals)	$4,987.28	$11.10	$4,998.38
2. For purchase of materials for use of United States Engineer School and instruction of engineer troops (materials)	1,311.12	98.15	1,409.27
3. For purchase and repair of instruments (instruments)	2,832.12	167.80	2,999.92
4. For library of the United States Engineer School, for purchase and binding of professional works of recent date treating of military and civil engineering (library)	116.39	142.87	259.26
Total	9,246.91	419.92	9,666.83
Balance unexpended, to be turned into the Treasury			333.17

III. TORPEDOES FOR HARBOR DEFENSE.

The following allotments from the above appropriation were made from time to time, and are available until expended:

1. Act August 18, 1890, for torpedo experiments and instruction of engineer troops in submarine mining:		
July 1, 1899, balance unexpended		$359.03
June 30, 1900, amount expended during fiscal year		359.03
2. Act March 3, 1897, for purchase of submarine-mining materials, etc., as recommended by the board on existing torpedo system:		
July 1, 1899, balance unexpended		1,471.40
June 30, 1900, amount expended during fiscal year		1,471.40
3. Act March 3, 1899, for torpedo experiments:		
July 1, 1899, balance unexpended		5,000.00
June 30, 1900, amount expended during fiscal year		2,284.24
July 1, 1900, balance unexpended		2,715.76
July 1, 1900, outstanding liabilities		9.72
July 1, 1900, balance available		2,706.04
4. Act March 3, 1899, for purchase of designated classes of torpedo material:		
July 1, 1899, balance unexpended		34,000.00
June 30, 1900, amount expended during fiscal year		11,477.55
July 1, 1900, balance unexpended		22,522.45
July 1, 1900, outstanding liabilities		21,470.79
July 1, 1900, balance available		1,051.66
5. Act July 7, 1898, torpedoes for harbor defense, January 1, 1899:		
July 1, 1899, balance unexpended		219.55
October 13, 1899, turned into the Treasury	$180.23	
June 30, 1900, amount expended during fiscal year	39.32	
		219.55

IV. Equipment of Engineer Troops, January 1, 1899.

1. Act July 7, 1898, for intrenching tools:

July 1, 1899, balance unexpended		$13.37
June 30, 1900, amount expended during fiscal year		13.37

2. Equipment of engineer troops, 1899, act January 5, 1899, for instruments, etc., for Alaska Exploring Expedition and for photographic materials, etc.:

July 1, 1899, balance unexpended		1,169.29
July 29, 1899, turned into the Treasury	$39.58	
August 3, 1899, withdrawn	30.51	
June 30, 1900, amount expended during fiscal year	1,099.20	
		1,169.29

3. Equipment of engineer troops, 1900, act March 3, 1899, for "Instruments, etc.:"

From the above appropriation the following allotments were assigned to me at various times during the fiscal year to fill requisitions for instruments, drawing materials, photographic supplies, etc., for use in Cuba, Porto Rico, the Philippine Islands, and for use of the several exploring expeditions in Alaska, viz:

August 1, 1899, amount allotted	500.00
September 6, 1899, amount allotted	500.00
October 5, 1899, amount allotted	1,000.00
October 16, 1899, amount allotted	1,500.00
February 17, 1900, amount allotted	1,500.00
March 16, 1900, amount allotted	2,100.00
April 16, 1900, amount allotted	550.00
May 14, 1900, by transfer from allotment for fitting out ponton trains (item 4)	911.31
June 25, 1900, amount allotted	400.00
Total of allotments	8,961.31
June 30, 1900, amount expended during fiscal year	8,149.61
July 1, 1900, balance unexpended	811.70
July 1, 1900, outstanding liabilities	782.30
July 1, 1900, balance available	29.40

4. Equipment of engineer troops, 1900:

Under date of October 17, 1899, the following allotment was assigned to me, to be applied to completing three divisions of advance-guard train and three divisions of reserve train of bridge and ponton equipage, act March 3, 1899, for fitting out ponton trains:

October 17, 1899, amount allotted		3,800.00
December 6, 1899, withdrawn	$1,000.00	
May 14, 1900, transferred to allotment for instruments, etc. (item 3)	911.31	
June 30, 1900, amount expended during fiscal year	981.78	
		2,893.09
July 1, 1900, balance unexpended		906.91
July 1, 1900, outstanding liabilities		906.91

V. Preservation and Repair of Fortifications.

Under date of April 24, 1900, the sum of $1,000 was assigned to me for the purchase of hygrometers and thermometers for use at artillery posts:

April 24, 1900, amount allotted	$1,000.00
June 30, 1900, amount expended during fiscal year	575.84
July 1, 1900, balance unexpended	424.16
July 1, 1900, outstanding liabilities	8.80
July 1, 1900, balance available	415.36

NEW APPROPRIATIONS.

The following items have been appropriated for the engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1901, by the act approved May 26, 1900, and assigned to me for disbursement:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For purchase of materials for use of United States Engineer School and for instruction of engineer troops (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For library of United States Engineer School; for purchase and binding of professional works of recent date, treating of military and civil engineering (library)	500.00
Total	10,000.00

ESTIMATES.

I. There will be required for the fiscal year ending June 30, 1902, the following for the engineer depot at Willets Point, N. Y.:

1. For incidental expenses of the depot, including fuel, lights, chemicals, stationery, hardware, extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, blacksmiths, draftsmen, printers, lithographers, photographers, engine drivers, *telegraph operators*, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers, repairs of and for materials to repair public buildings, machinery, and unforeseen expenses	$5,000.00
2. For the purchase of materials for use of United States Engineer School and for instruction of engineer troops at Fort Totten, Willets Point, in their special duties as sappers and miners, for land and submarine mines, pontoniers, torpedo drill, and signaling	1,500.00
3. For purchase and repair of instruments, to be issued to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers, for use on public works and surveys	3,000.00
4. For purchase and binding of professional works of recent date treating of military and civil engineering, and kindred scientific subjects, for library of the United States Engineer School	500.00
5. For *an addition to the building containing the collection of engineering models used for illustration and instruction, and the library of the United States Engineer School, to be available until expended*	12.000.00
Total	22,000.00

The changes from the text of the last act of Congress making appropriations for the engineer depot are indicated in italics.

Remark under Paragraph I, item 1.—Extra-duty pay for telegraph operators is recommended because it is not practicable to relieve the engineer soldiers acting as operators. Seldom is there more than one man available for this duty, and hence his service is continuous and confining.

Remark under Paragraph I, item 5.—The desired addition to the building is rendered necessary by the accumulation of models and books.

John G. D. Knight,
Major, Corps of Engineers, U. S. A.

Fort Totten, *Willets Point, N. Y., July 20, 1900.*

ABSTRACT OF PROPOSALS.

1. For furnishing surveying instruments, drawing instruments, drawing materials, etc., as may be called for prior to June 30, 1900. Proposals opened July 29, 1899.

No.	Name and address of bidder.	Prices as in makers' catalogues.
1	Keuffel & Esser Co., 127 Fulton street, New York, N.Y.	Submitted catalogue with prices and gives 15 per cent discount on catalogue prices.
2	Kolesch & Co., 155 Fulton street, New York, N.Y.	Submitted list of articles with prices attached; also catalogue with prices, and gives 15 per cent discount on catalogue prices.
3	F. E. Brandis & Sons Co., 814 Gates avenue, Brooklyn, N.Y.	Submitted catalogue with prices marked therein in red ink.
4	A. S. Aloe & Co., 415 North Broadway, St. Louis, Mo.	Submitted discount sheet with catalogue; gives 10 per cent discount on all surveying instruments.
5	C. L. Berger & Sons, 9 Province court, Boston, Mass.	Submitted catalogue with prices and gives 10 per cent discount from catalogue prices.
6	Geo. N. Saegmuller, Second street and Maryland avenue, Washington, D. C.	Submitted catalogue with prices and gives 5 per cent discount from catalogue prices.
7	The A. Lietz Co., 422 Sacramento street, San Francisco, Cal.	Submitted catalogue with prices and gives 3 per cent discount from catalogue prices.

Bid No. 1 was accepted for furnishing all surveying instruments and nearly all of the other articles shown in catalogue. Bid No. 4 was accepted for furnishing a few minor articles. The quantity of the articles accepted of these two bids depended on the amount that may be called for during the fiscal year.

2. For furnishing labor and materials for repairing extension of engineer wharf at Willets Point, N. Y., opened at 12 m., August 23, 1899, viz: Replacing 56 bearing piles; replacing 20 fender piles; replacing 16,000 B. M. lumber for stringers, flooring, etc.; furnishing 3,200 pounds iron fastenings.

No.	Name and address of bidder.	Total amount of bid.
1	Hugh Hart, 150 Pearsall street, Long Island City, N. Y	$2,560.75
2	George Humphreys, 575 Clinton street, Brooklyn, N. Y	3,121.00
3	James Du Bois, 11 Broadway, New York, N. Y	3,184.00
4	Patrick J. Mara, Flushing, N. Y	2,833.75

The award was made to Mr. Hugh Hart.

3. For furnishing clear white pine timber for ponton and bridge equipage, opened November 23, 1899.

No.	Name and address of bidder.	Article.	Price per $1,000 feet B. M.	Total of bid.
1	John McClave, Twenty-first street and Eleventh avenue, New York, N. Y.	14,549 feet B. M. clear white pine timber.	$125.00	$1,818.63

This bid was accepted for delivery on or before June 15, 1900, but on April 12, 1900, the bidder reported his inability to furnish the grade of lumber specified.

4. *For furnishing 293 compound plugs for buoyant and ground mines, and for circuit-closer buoys, extra brass and iron glands, and 50,000 brass washers, opened at 12 m., February 15, 1900.*

No.	Name and address of bidder.	Total amount of bid.
1	The Continental Iron Works, West and Calyer streets, Brooklyn, N. Y	$4,801.53
2	F. E. Brandis & Sons Co., 814 Gates avenue, Brooklyn, N. Y	4,222.35
3	Charles L. Rowland, 102 Greene street, Brooklyn, N. Y	3,764.45
4	William J. Blair, 24 to 27 West street, New York, N. Y	2,777.16

Awards for the above were made as follows:

3. Charles L. Rowland was awarded the 50,000 brass washers, at 78 cents per pound.

4. William J. Blair was awarded under formal contract all compound plugs and glands; total amount of contract, $1,689.66.

5. *For furnishing electrical fuses and cut-outs, opened January 29, 1900.*

No.	Name and address of bidder.	Articles.			Total of bid.
		Fuses (12,000).	Cut-outs.		
			8,000 7″ wire.	4,000 9″ wire.	
1	Laflin & Rand Powder Co., 99 Cedar street, New York, N. Y	$0.10	$0 06	$0.06¼	$1,930
2	Smith Electrical Works, Pompton Lakes, N. J	.10	.06	.06¼	1,930
3	James S. Barron & Co., 24-30 Hudson street, New York, N. Y	.08	.06	.06	1,680

The award was made to Messrs. James S. Barron & Co.

6. *For furnishing 1,050 aluminum metal cases, opened March 5, 1900.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	The American Ordnance Co., Bridgeport, Conn	$15.84	$16,632.00
2	Foot, Pierson & Co., 82 Fulton street, New York, N. Y	3.70	3,885.00
3	The Keuffel & Esser Co., 127 Fulton street, New York, N. Y	3.25	3,412.50
4	The Western Electric Co., 57-67 Bethune street, New York, N. Y	4.55	4,777.50
5	F. E. Brandis Sons & Co., 814 Gates avenue, Brooklyn, N. Y	2.10	2,205.00
6	Wm. J. Blair, 24 West street, New York, N. Y	2.48¼	2,609.25
7	Frederick Pearce, 18 Rose street, New York, N. Y	2.25	2,362.50

The award was made to Messrs. F. E. Brandis Sons & Co.

7. *For furnishing Kerite insulated wires, opened February 28, 1900.*

No.	Name and address of bidder.	Articles.		Total of bid.
		66,000 feet No. 16, per 1,000 feet.	26,400 feet No. 12, per 1,000 feet.	
1	India Rubber & Gutta Percha Insulating Co., 15 Cortlandt street, New York, N. Y	$6.25	$10.50	$689.70
2	Standard Underground Cable Co., 18 Cortlandt street, New York, N. Y	8.25	19.00	1,046.10
3	General Electric Co., 44 Broad street, New York, N. Y	17.40	24.40	1,792.56
4	Safety Insulated Wire & Cable Co., 229 West Twenty-eighth street, New York, N. Y	10.00	21.00	1,214.40
5	William R. Brixey, 203 Broadway, New York, N. Y	11.50	23.50	1,379.40

The award was made to Mr. William R. Brixey, he being the only bidder furnishing a satisfactory sample of the wire specified.

8. *For furnishing five slow-speed rotary transformers, opened February 23, 1900.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	Wagner Electric Manufacturing Co., St. Louis, Mo	$174.00	$870.00
2	Blackall & Baldwin, 39 Cortlandt street, New York, N. Y	224.75	1,023.75
3	Eddy Electric Manufacturing Co., 149 Broadway, New York, N. Y	190.00	950.00
4	Jas. S. Barron & Co., 24 Hudson street, New York, N. Y	220.00	1,100.00
5	R. S. Bishop & Co., 31 Broadway, New York, N. Y	255.00	1,275.00

The award was made to the Wagner Electric Manufacturing Company.

9. *For furnishing six oil engines, 4-horsepower, opened March 16, 1900.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	The De La Vergne Refrigerating Machine Co., foot of East One hundred and thirty-eighth street, New York, N. Y	$660.00	$3,996.00

The above bid for Hornsby-Akroyd oil engines was accepted.

10. *For furnishing six electrical switchboards, opened April 13, 1900.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	Foote, Pierson & Co., 82 Fulton street, New York, N. Y	$420.00	$2,520.00
2	General Incandescent Arc Light Co., 578 First avenue, New York, N. Y	440.00	2,640.00
3	Western Electric Co., 57-67 Bethune street, New York, N. Y	380.00	2,280.00

The award was made to the Western Electric Company.

11. *For furnishing thermometers and hygrometers, opened April 30, 1900.*

No.	Name and address of bidder.	Thermometers, 500 (price for one).	Hygrometers, 100 (price for one).	Total of bid.
1	T. S. & J. D. Negus, 140 Water street, New York, N. Y	$1.00	$2.45	$745.00
2	Queen & Co., 1010 Chestnut street, Philadelphia, Pa	1.00	4.50	950.00
3	Chas. J. Tagliabue, 53 Fulton street, New York, N. Y	.66	2.00	530.00

Bid No. 1 was accepted for 100 hygrometers, at $2.45 each; sample submitted being superior to other samples.

Bid No. 3 was accepted for 500 thermometers, at 66 cents each.

12. *For furnishing 18,138 feet B. M. Oregon pine timber for ponton and bridge equipage, opened May 4, 1900.*

No.	Name and address of bidder.	Price per 1,000 feet B. M.	Total of bid.
1	Watson & Pittinger, 412 Carroll street, Brooklyn, N. Y	$75.00	$1,360.50
2	John McClave, Twenty-first street and Eleventh avenue, New York, N. Y	90.00	1,632.60
3	Church E. Gates & Co., East One hundred and thirty-eighth street, New York, N. Y	50.00	906.91

The award was made to Messrs. Church E. Gates & Co.

13. For furnishing the following mushroom anchors and iron coupling boxes, opened at 12 m., May 7, 1900, viz:

Anchors, 500 pounds	200
Jointing boxes:	
Multiple	900
Single	1,500
Cut-out boxes and extra bolts and binding screws	400

Junction boxes:	
Grand	110
Triple	375
Single, large	800
Single small	200

No.	Name and address of bidder.	Total amount of bid.
1	R. S. Bishop, 31 Broadway, New York, N. Y	$15,798.50
2	Ellicott Machine Co., Canton, Baltimore, Md	14,029.90
3	Marine Manufacturing and Supply Co., 138 South street, New York, N. Y	a1,440.00
4	Western Electric Co., 57–67 Bethune street, New York, N. Y	b12,458.50
5	New Jersey Foundry and Machine Co., 26 Cortlandt street, New York, N. Y	14,401.00
6	Roberts Machine Co., Collegeville, Pa	20,700.85
7	Jas. S. Barron & Co., 24 Hudson street, New York, N. Y	35,249.25
8	The Continental Iron Works, West & Calyer streets, Brooklyn, N. Y	23,819.00
9	Geo. B. Sennett & Co., Youngstown, Ohio	a2,250.00
10	Morton Iron Works, 102 Greene street, Brooklyn, N. Y	17,110.00
11	Petersburgh Foundry Co., Petersburg, Va	a1,950.00

a For anchors only.

b Exclusive of anchors.

Awards for the above were made as follows:

Bid No. 2 was accepted for all junction boxes and extra bolts and clamps, award made under formal contract, amounting to $5,749.90.

Bid No. 4 was accepted for all jointing boxes and extra binding screws, award made under formal contract, amounting to $2,863.50.

Bid No. 6 was accepted for the 400 cut-out boxes, award made under formal contract, amounting to $760.

Bid No. 10 was accepted for the 200 500-pound anchors, for delivery within thirty days, without formal contract, amounting to $1,290.

Total amount involved in awarding the above, $10,663.40.

14. For furnishing the following forgings, etc., opened June 18, 1900, viz: 1,700 mine shackles, 2,600 anchor shackles, 7,500 split pins for same, 1,100 split keys for mines, and 3,500 mooring sockets.

No.	Name and address of bidder.	Price per one of each.					Total of bid.
		Mine shackles.	Anchor shackles.	Split pins.	Split keys.	Mooring sockets.	
		Cents.	*Cents.*	*Cents.*	*Cents.*		
1	Continental Iron Works, West and Calyer streets, Brooklyn, N. Y	57	63	0.6	6.75	No bid.	$2,726.25
2	Morton Iron Works, 102 Greene street, Brooklyn, N. Y	42.4	68.5	.724	6.5	$0.89	5,742.60
3	Logan Iron Works, Commercial and Clay streets, Brooklyn, N. Y	56	76	.7	No bid.	1.32	7,600.50
4	Thomas Laughlin & Co., 143 Fore street, Portland, Me	36	70	1	10	.85	5,592.00
5	New Jersey Foundry and Machine Co., 26 Cortlandt street, New York, N. Y	33.75	46.50	.75	5.4	.60	3,998.40
6	Manning, Maxwell & Moore, 111 Liberty street, New York, N. Y	39	77	2.8	4.50	.92	6,144.50
7	Manhattan Hardware Co., 497 Third avenue, New York, N. Y	38.50	73	4	No bid.	.88	5,932.50

Awards under written acceptance were made as follows:

Bid No. 1, for 7,500 split keys for shackles, amounting to $45.

Bid No. 5, for all shackles and mooring sockets, at 60 cents, amounting to $3,882.75.

Bid No. 6, for 1,100 split keys for mines, amounting to $49.50.

Total amount involved in awarding the above, $3,977.25.

List of contracts in force during the fiscal year.

1. For compound plugs for mine cases and extra glands for same:
    Name of contractor: Wm. J. Blair, New York, N. Y.
    Date of contract: February 24, 1900.
    Date of approval: March 27, 1900.
    Time for commencement: April 7, 1900.
    Time for completion: May 1, 1900.
    Contract extended to May 16, 1900.
2. For cut-out boxes:
    Name of contractor: The Roberts Machine Company, Collegeville, Pa.
    Date of contract: May 22, 1900.
    Date of approval: June 4, 1900.
    Time for commencement: June 15, 1900.
    Time for completion: August 31, 1900.
3. For four kinds of junction boxes and extra bolts and clamps:
    Name of contractor: Charles E. Ellicott, Canton, Md.
    Date of contract: May 25, 1900.
    Date of approval: June 11, 1900.
    Time of commencement: June 23, 1900.
    Time for completion: August 31, 1900.
4. For two kinds of jointing boxes and extra binding screws:
    Name of contractor: Western Electric Company, Chicago, Ill.
    Date of contract: May 31, 1900.
    Date of approval: July 2, 1900.
    Date of commencement: July 14, 1900.
    Time for completion: August 31, 1900.

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